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—PRELIMINARY DRAFT—

Environmental Assessment

In support of the:

Implementation of Remediation Activities for Selected Contaminated Mine Drainage (CMD) Sites

at the

Big South Fork National River and Recreation Area

McCreary County, Kentucky

U.S. Department of the Interior – National Park Service
U.S. Department of Energy – National Energy Technology Laboratory

June 15, 2001

AMEC Earth & Environmental, Inc.
6626 Central Avenue Pike
Knoxville, Tennessee 37912

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WATER RESOURCES DIVISION
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New Mexico

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ENVIRONMENTAL ASSESSMENT
SIGNATURE PAGE

LEAD AGENCY:	DEPARTMENT OF THE INTERIOR, NATIONAL PARK SERVICE (NPS)
COOPERATING AGENCIES:	None
TITLE OF PROPOSED ACTION:	Implementation of Remediation Activities for Selected Contaminated Mine Drainage (CMD) Sites at the Big South Fork National River and Recreation Area
AFFECTED JURISDICTION:	McCreary County, Kentucky
POINT OF CONTACT:	_________ _________, EA Project Officer, NPS, Big South Fork NRRA, 4564 Leatherwood Road, Oneida, TN 37841, Telephone: (___) ___-____
PROPONENTS:	Department of the Interior, National Park Service (NPS) and Department of Energy, National Energy Technology Laboratory (DOE-NETL)

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DOCUMENT DESIGNATION: Preliminary Draft Environmental Assessment

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EXECUTIVE SUMMARY

It is the intent of the National Park Service (NPS) and the U.S. Department of Energy, National Energy Technology Laboratory (DOE-NETL) to perform remediation activities at several contaminated mine drainage (CMD) sites within the Commonwealth of Kentucky portion of the Big South Fork National River and Recreation Area (BISO) to help improve the water quality and aquatic habitat in the Big South Fork of the Cumberland River (BSF) and its tributaries. This Environmental Assessment (EA) has been prepared to fully identify, document, and address the potential physical, environmental, cultural, and socioeconomic impacts associated with implementation of the proposed actions in accordance with the National Environmental Policy Act of 1969 (NEPA; 42 USC 4321 et seq.).

The purpose of the proposed action is to limit and/or prevent, to the extent possible, CMD from further impacting tributary streams in the project area, and subsequently the BSF. The proposed project would benefit the environment. The NPS proposes to mitigate CMD and/or prevent the production of CMD at eight sites within the Kentucky portion of the BISO using grading and revegetation, passive treatment systems [i.e., anoxic limestone drains (ALDs), constructed wetlands, polishing ponds], and/or water source controls (i.e., lined channels, regrading) to prevent or deter surface water from contacting mine spoils. The project sites proposed for remediation are as follows:

- Laurel Branch (Stream Spoils and Confluence Area)
- Laurel Branch Confluence
- Devils Creek
- Blue Heron Spoils
- Blair Creek
- Worley Mine #88
- Worley Mine #86
- Slavey Hollow
- Nancy Graves

NEPA, CEQ regulations, and NPS-12 require that all reasonable alternatives be rigorously explored and objectively evaluated. This EA examines in-depth three alternatives, a Preferred Action Alternative, a Modified Action Alternative, and a No Action Alternative, defined as follows:

- ➢ Alternative 1: Preferred Action Alternative: Implement a series of environmental improvement actions throughout the affected sites, including the construction of ALDs, constructed wetland treatment systems, and lined channels within the project area.

- ➢ Alternative 2: Modified Action Alternative: Implement many of the same actions as included in the Preferred Action Alternative with a few variations. The differences between Alternatives 1 and 2 are primarily related to the method by which remediation is proposed at certain project sites.

- ➢ Alternative 3: No Action Alternative: Implement no actions to remediate sites adversely affected by CMD.

Implementation of the Preferred Action Alternative (Alternative 1) is anticipated to result in *long-term beneficial* effects to water and biological resources within the project area. *Short-term adverse* impacts to the local environment would include increased air emissions from vehicles and equipment, noise levels, potential on-site soil erosion and consequent sedimentation of local surface waters, limited recreational use of trails in the project area during construction, and potential impacts to on-site cultural resources. These *short-term adverse* impacts would be lowered to acceptable levels with implementation of the common mitigation measures identified in Section 5.2.2, and the resource area-specific mitigation measures identified throughout Sections 5.3 through 5.13. Implementation of the proposed actions would not adversely impact geology, topography, ground water resources, socioeconomic resources, environmental justice issues, infrastructure, or hazardous materials and wastes.

Implementation of the Modified Action Alternative (Alternative 2) would be anticipated to result in similar impacts to those identified for Alternative 1. The alternative configurations of the proposed remediation measures as associated with this Modified Action Alternative would not be expected to result in significantly different effects to water resources, including water quality; the primary differences between Alternatives 1 and 2 are associated with logistical considerations during construction periods. Of these logistical considerations, implementation of Alternative 2 at the Mine #88 area would involve sealing the mine entry and directing additional water to the Mine #86 adit and treatment system. This would negligibly increase the discharge of Mine #86 and potentially other discharge points, but would result in less disturbance, and perhaps greater effectiveness of treatment, to the Mine #88 CMD discharge.

Alternative 3, the No Action Alternative, was not found to satisfy the purpose and need for the project, as no remedial actions would occur under this alternative. Without implementing the proposed actions, CMD will continue to adversely affect local streams within the project area.

Each of the three considered alternatives, *without implementation of the mitigation measures specified in this EA*, would potentially result in significant, or potentially significant, impacts to the current environmental setting across several technical areas. However, through implementation of specific, required mitigation measures, all potential anticipated impacts would be reduced below levels of significance.

The EA examines the potential cumulative effects of implementing the proposed projects. This analysis identifies that implementation of either Alternative 1 or 2 would result in long-term positive impacts to water quality and aquatic resources within the project area. The Preferred Action Alternative and the Competing Build Alternative effectively provide for the remediation of CMD sites within the project area, while the No Action Alternative would not satisfy the purpose and need for the project.

This EA recommends that the NPS elect to implement a combination of the Preferred Action Alternative and the Modified Action Alternative. Specifically, it is recommended that Alternative 1, the Preferred Action Alternative, be implemented with respect to the following project sites: Laurel Branch Channel, Laurel Branch Confluence, Devils Creek, Blue Heron Spoils, Blair Creek, Worley Mine #86, Slavey Hollow, and Nancy Graves. This EA recommends that the NPS implement Alternative 2, the Modified Action Alternative, with respect to the Worley Mine # 88 site. Implementation of these activities would serve to fulfill the purpose of and need for the proposed action, while minimizing the potential for impact.

—PRELIMINARY DRAFT—

Environmental Assessment
Remediation of Selected Contaminated Mine Drainages

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LIST OF ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
ALD	Anoxic Limestone Drain
AHPA	Archeological and Historic Data Preservation Act
AIRFA	American Indian Religious Freedom Act
AML	Abandoned Mine Land
AMSL	Above Mean Sea Level
ARPA	Archeological Resources Protection Act
BISO	Big South Fork National River and Recreation Area
BMP	Best Management Practice
BSF	Big South Fork of the Cumberland River
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response and Liability Act
cfs	Cubic feet per second
CMD	Contaminated Mine Drainage
CWA	Clean Water Act
District	McCreary County Water District
DOE-NETL	U.S. Department of Energy National Energy Technology Laboratory
DOI	U.S. Department of the Interior
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
° F	Degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FWPCA	Federal Water Pollution Control Act
gpm	Gallons per Minute
HDPE	High-density Polyethylene (Liner)
IICEP	Intergovernmental and Interagency Coordination of Environmental Planning
K & T	Kentucky and Tennessee [Railroad]
KAR	Kentucky Administrative Regulations
KDEP	Kentucky Department of Environmental Protection

KPDES	Kentucky Pollutant Discharge Elimination System
KRS	Kentucky Revised Statutes
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves and Repatriation Act
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NPS-12	NPS NEPA Compliance Guideline regulation suite
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
O & W	Oneida and Western [Railroad]
ONRW	Outstanding National Resource Water
OSRW	Outstanding State Resource Water
PCR	Primary Contact Recreation
PL	Public Law
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Office
SKRECC	South Kentucky Rural Electric Cooperative Corporation
SRC	Secondary Contact Recreation
TDEC	Tennessee Department of Environment and Conservation
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United State Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Society
WAH	Warmwater Aquatic Habitat

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1.0 Purpose and Need for the Proposed Actions

1.1 Introduction

1.1.1 Project Overview

It is the intent of the National Park Service (NPS) and the U.S. Department of Energy, National Energy Technology Laboratory (DOE-NETL) to perform remediation activities at several contaminated mine drainage (CMD) sites within the Commonwealth of Kentucky portion of the Big South Fork National River and Recreation Area (BISO) to help improve the water quality and aquatic habitat in the Big South Fork of the Cumberland River (BSF) and its tributaries. The purpose of the proposed action is to limit and/or prevent, to the extent possible, CMD from further impacting tributary streams in the project area, and subsequently the BSF. The proposed project would benefit the environment.

This Environmental Assessment (EA) serves to define the proposed actions associated with this project, explore possible alternatives to the proposed actions, and identify the affected environment and environmental consequences associated with the proposed action in accordance with the National Environmental Policy Act of 1969 (NEPA; 42 USC 4321 *et seq*.). The remediation project is being performed collectively with, and contracted through, the DOE-NETL, as utilized for technical expertise with regard to CMD issues.

The project area within the BISO is primarily impacted by mine discharges and reactive mine spoils discarded from up-slope abandoned underground coal mine entries. The project consists of remedial actions designed to improve water quality of surface waters affected by CMD from selected abandoned coal mines and associated spoils. For the purposes of this document, CMD refers to groundwater or runoff surface waters that have been affected by remnants of oxidized pyrite and/or other sulfur-containing minerals associated with coal mines or related spoils. This water consequently has a low pH, high acidity, and/or high metal concentrations. Chemical processes that lead to CMD are described in **Appendix B**. Abatement of CMD may be accomplished through two basic means:

1) Source Controls: These methods prevent or control the formation of CMD by preventing one or more of the basic producers of CMD (air, water, or pyritic materials) from coming into contact.

2) Treatment Systems: These systems control the effects of CMD on the receiving waters by removing or reducing the concentration of the harmful constituents of CMD (e.g. iron, other trace metals, acidity) from the discharge after CMD has formed. These methods usually employ the addition of chemicals (actively or passively) or enhancement of biogeochemical reactions to raise the pH of the water followed by precipitation of the potentially harmful constituents.

Prevention and/or control of the production of CMD may be accomplished through source controls (i.e., site reclamation, water source controls, mine seals, subsurface injection, bacterial inhibitor application). Treatment of CMD may be accomplished by chemical treatment, in-stream alkaline addition, and/or various passive treatment methods (i.e., anoxic limestone drains [ALDs], constructed wetlands, polishing ponds). Passive treatment systems use natural chemical and biological processes (i.e., precipitation and microbial and chemical oxidation and reduction) to decrease metal concentrations and neutralize excess acidity by generation of alkalinity. Constructed wetland and ALD technology is relatively new (approximately 15 years) but has proven to be an effective, low-cost, low maintenance alternative to active treatment of CMD (*Watzlaf and Hyman 1995*). Methods used in the abatement of CMD are further described in **Table 1-1**.

Table 1-1 Current Methods Used to in the Abatement of CMD

Abatement Methods	Descriptions
Site Reclamation	Site reclamation includes grading and revegetation, re-mining, and/or spoil removal. Grading activities are generally performed to improve drainage and increase slope stability. Soil amendments (e.g., fertilizers, limestone, and biosolids) are often added to soils during regrading to improve revegetation success. Re-mining involves the additional removal of coal and coal byproducts that often contribute to CMD.
Water Source Controls	Water source controls are "measures that are employed to keep water from contacting and infiltrating acid generating materials on acid mine land (AML) thereby preventing and/or reducing CMD discharges" (*Gannett Fleming, Inc. 1998*). Water source controls include diversion/isolation of water (i.e., lined channels), stormwater interception, horizontal barriers, and vertical barriers.
Mine Seals	Mine seals exclude the passage of air to mines and are used to prevent or control the flow of water into mine openings. Dry seals prevent the passage of air and water. Wet seals prevent the passage of air but allow discharge to flow out.
Subsurface Injection	Subsurface injection includes mine injection, overburden grouting, and toxic material encapsulation. These methods are used to stabilize mines and reduce the production of CMD, limit groundwater flow and prevent infiltration, and encapsulate pocket containing acid producing materials.
Bacterial Inhibitor Application	This method involves the application of bactericides, detergents, and/or organic sludge to kill the bacteria (*Thiobacillus ferroxidans*) known to be critical in the catalysis of the pyrite oxidation process.
Chemical Treatment	Chemical treatment systems use mechanical feeders, mixers, and settling basins to treat CMD. Chemicals typically used to treat CMD include calcium carbonate (limestone), calcium hydroxide (hydrated lime), sodium carbonate (soda ash or briquettes), and sodium hydroxide (caustic soda).
In-stream Alkaline Addition	With this treatment technique, "limestone aggregates are mechanically abraded to provide slurry dosing directly to CMD affected streams" (*Gannett Fleming, Inc. 1998*).
Anoxic Limestone Drains (ALDs)	ALDs function solely to add alkalinity to mine drainage. These systems are limited to drainages that contain no aluminum or ferric iron, because aluminum will precipitate in the drain, reducing permeability; and ferric iron will precipitate on the limestone surface, reducing its dissolution rate (*Watzlaf and Hyman 1995*). ALDs are typically used in combination with aerobic and anaerobic surface-flow wetlands.
Constructed Aerobic Surface-flow Wetlands and Settling Ponds	Aerobic surface-flow wetlands are constructed wetlands, not natural systems. They are generally constructed to treat net alkaline water, but may be used to treat net acidic water if other unit operations to generate alkalinity are incorporated into the system. Aerobic wetlands are often shallow ponds allowing oxygen transfer and plants such as cattails to flourish. These systems function to promote oxidation, precipitation, and settling of iron and manganese oxyhydroxides (*Watzlaf and Hyman 1995*).
Constructed Anaerobic Surface-flow Wetlands	Anaerobic surface-flow wetlands are constructed wetlands, not natural systems. They vary in depth from approximately one to twelve inches, contain an organic substrate, and are planted with emergent vegetation such as cattails. These systems can remove metals such as iron and aluminum and have had limited success reducing acidity in mine waters.
Polishing Pond	A polishing pond is a shallow surface-flow wetland, 1-12 inches deep, that is planted with aquatic and/or wetland vegetation (i.e., cattails). These systems can remove metals such as iron and aluminum through biological processes and filtration.
Constructed Vertical Flow Wetlands	Vertical flow wetlands are constructed wetlands, not natural systems. They may be used to treat highly acidic mine drainage. These systems consist of an organic substrate layer placed over a limestone layer and an underdrain piping system that collects water as it passes through the substrate layers. These systems have been successful in reducing acidity and generating alkalinity in mine waters.

1.1.2 Location

The BISO is located on the Cumberland Plateau, approximately 50 miles northwest of Knoxville, Tennessee and encompasses approximately 125,000 acres in portions of Fentress, Scott, Pickett, and Morgan Counties, Tennessee, and McCreary County, Kentucky (*see* **Figure 1-1 in Appendix A**). The project area includes eight sites totaling approximately 22 acres located along a 12-mile section of the BSF approximately five miles north of the Kentucky/Tennessee border in McCreary County, Kentucky (see **Figure 1-2**). Counties surrounding the BISO contain scattered, low-density rural development with no major urban areas.

1.1.3 Historical Land Use

The BSF region has been extensively mined for coal since the turn of the century with some mines still operating in the BSF watershed. Influx of settlers to the BSF area began in the early 1800's, drilling for salt and mining for niter (potassium nitrate [KNO_3]) began in 1812, and the first commercial oil well in North America was drilled in this area in 1818. Extensive coal mining and timber harvesting occurred from the 1880's to the 1960's and have had significant environmental impacts on the region, including the project area [*Tennessee Department of Environment and Conservation (TDEC) 1997*].

The Stearns Coal and Lumber Company was founded by J.S. Stearns in the early 1900's and commercial coal mining began along the Kentucky portion of the BSF when this company built a railroad to Barthell on Roaring Paunch Creek (Stearns Ranger District 1966). The Stearns Company, which was the largest coal mining company that operated in what is now the BISO, established a large-scale underground mining operation, employing approximately 1,300 miners. The Stearns' Worley mines were opened in 1906 and the region continued to grow. Coal mining in the Stearns area peaked around 1929, and in 1938, the Stearns Company opened the Blue Heron Mine, which was subsequently closed in 1963 due to economic reasons (*TDEC 1997*).

As a result of these and other past mining operations, remnants of mining towns, railroad spurs, mine sites, and haul roads remain throughout the region and specifically throughout the project area. In conjunction with the coal mining operations, waste materials were generally deposited in rock dumps near the mines. Coal spoils and pyrolized gob piles occur throughout the project area and continue to be a source of metal-laden acidic drainage (CMD; Contaminated Mine Drainage).

1.1.4 Current Land Use

The Secretary of the Army established the BISO in 1974 by Title I of Public Law (PL) 93-251, H.R. 10203. The act was amended by PL 94-587 in 1976 and PL101-561 in 1990. On November 15, 1990, the Secretary of Interior assumed responsibility of Federal lands, water, interests therein, and improvements thereon within the BISO.

The BISO was established for the following purposes, as defined by Section 108(a) of PL 93-21 as amended by PL 94-587 and PL 101-561:

- To conserve and interpret cultural, historic, geologic, fish and wildlife, archeological, scenic, and recreational values;
- To preserve the free flowing BSF and portions of its tributaries;
- To preserve the natural integrity of the scenic gorges and valleys; and
- To develop the area's potential for healthful outdoor recreation.

Legislature establishing the BISO both defines activities allowed within its boundaries, and identifies restrictions (16 USC 460ee). When the BISO was created, the land had suffered from long-term intensive land use including coal mining, timber harvesting, oil and gas operations, and a large network of unmaintained roads. Since 1974, some efforts have been made to minimize the effect of mine spoils on surface waters. Mine reclamation efforts have primarily focused on the Blue Heron, Worley, and Alum Ford areas; these efforts were largely funded by the U.S. Department of the Interior—Office of Surface Mining. Additional reclamation activities have been completed within the watershed, but outside the BISO, by TDEC and the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS).

The portions of the BISO on which the proposed project is focused are severely impacted by CMD. However, the general area in which the sites are located offers numerous recreational opportunities including fishing, swimming, hiking, biking, horseback riding, back-county camping, hunting, and nature study. The Blair Creek Loop, Blair Creek River Trail, and the Kentucky Trail traverse the general project area and in some cases cross or occur in close proximity to the project sites, as shown in **Figure 1-3**.

Additional recreational facilities that are located in the general project area include the Blue Heron historic mining community and the Big South Fork Scenic Railway, both of which are popular tourist attractions.

1.1.5 Management Planning at BISO

Management of the BISO is driven by the U.S. Congress' intent for the area, as well as NPS regulations, to conduct management planning in order to ensure that development (or *non*-development) of the BISO is conducted in a well-suited, environmentally-sound, orderly manner. Under requirements mandated by Congress and subsequently the NPS, the BISO has been operating under a Master Plan prepared in 1981 by the U.S. Army Corps of Engineers (USACE). This Master Plan provided for initial establishment and development of the BISO under USACE jurisdiction. In 1991, jurisdictional responsibility for the BISO was transferred to the NPS. The NPS is currently preparing a draft BISO General Management Plan and Environmental Impact Statement (EIS; NPS 2000).

1.1.5.1 General Management at BISO

As stated above, the BISO General Management Plan/EIS is currently in its draft stage. The purpose of the plan/EIS is to:

- Clarify management requirements within the BISO as a unit administered by the NPS;
- Examine existing and desired facilities and resources within the BISO;
- Explore management alternatives including future development needs and desired visitor experiences; and
- Establish procedures for future management planning.

Presently the NPS is exploring primarily three management options:

1) To create an overall rustic retreat with minimal facilities except in selected areas;
2) To provide for resource-based recreation and convenient facilities around a primitive core; and
3) To continue managing the BISO under current conditions.

The plan/EIS evaluates each option and its potential effects on resources and visitor experiences. To ensure that the public is integrally involved in the planning process, the draft plan/EIS has been available for public review and comments (NPS 2000).

1.1.5.2 Water Resources Management

To increase watershed protection and the management of water resources within the BISO, the NPS completed its first BISO Water Resources Management Plan in 1997 (TDEC 1997). The plan outlines management objectives with respect to water environments, water quality, water resources inventory and monitoring, mining, oil and gas, recreation area operations, cooperative management, and public education/public awareness (see **Table 1-2**).

To help assess water quality impacts of CMD within the BISO, the NPS completed a three-year investigation to identify, characterize, and prioritize water quality impacts that result from CMD in the project area. The products of this investigation include an inventory of significant CMD sites within the BISO, a prioritization of the sites relative to their direct impact on the BSF, and concepts for potential remediation methods for sites which are most likely to improve the water quality of the BSF. Remedial projects considered as potential remediation options include passive wetland treatment systems, ALDs, lined channels, and removal of spoils or gob piles. Based on previous characterization efforts and consideration of potential remediation options, the NPS identified the following sites, in priority order, for remediation:

1. Laurel Branch;
2. Devils Creek;
3. Blue Heron Spoils;
4. Three West Hollow;
5. Blair Creek;
6. Worley Mine #88;
7. Worley Mine #86;
8. Slavey Hollow; and
9. Nancy Graves.

With the exception of the Three West Hollow site, these are the CMD locations included in the proposed project. Remediation of the Three West Hollow site is likely not warranted at this time, and remedial actions are not proposed at this time and will not be addressed further in this EA.

1.1.6 Rational for Preparing an Environmental Assessment

The NPS, through and with the assistance of the DOE-NETL, intends to implement projects to remediate selected sites severely impacted by CMD to improve water quality of tributary streams and the BSF. As defined by NEPA, this project constitutes a "major federal action", subsequently requiring analysis subject to the specific procedural provisions of NEPA. The NPS and the DOE-NETL have determined that an EA will likely provide sufficient level-of-detail in NEPA analysis, and will comprehensively identify, analyze, and discuss the potential environmental, cultural, and socioeconomic impacts of practical remediation alternatives most likely to improve the water quality of the BSF.

1.1.7 Environmental Assessment Framework

This EA was prepared to document the potential for environmental impacts resulting from remedial actions at the eight sites affected by CMD identified in **Section 1.1.5.2**. The purpose of the proposed project is to improve the environment and significant adverse impacts are not anticipated. This EA was prepared under the provisions of, and in accordance with, NEPA, the Council on Environmental Quality (CEQ) Regulations Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508), and the NPS NEPA Compliance Guideline regulation suite (NPS-12). This EA consists of the following sections:

- Section 1.0 – Purpose and Need of the Proposed Actions;
- Section 2.0 – Description of the Proposed Actions;
- Section 3.0 – Alternatives Considered;
- Section 4.0 – Affected Environment;
- Section 5.0 – Environmental Consequences;
- Section 6.0 – Comparison of Alternatives and Conclusions; and
- Section 7.0 – References.

1.2 Purpose and Need for the Proposed Actions

The objective of this project is to improve water quality of surface waters at the selected CMD sites using low maintenance techniques (i.e., water source controls and/or passive treatment). Legal and administrative drivers for the remediation projects include the following.

- State water quality standards. The BSF (River Mile 55.2 to River Mile 45.0) is designated for the following uses: warmwater aquatic habitat (WAH); primary contact recreation (PCR); secondary contact recreation (SCR), and Outstanding Resource Water (*ORW, TDEC 1997*). Currently, the BSF is not meeting its designated use criteria in certain portions of the project area (*Bakaletz, personal communication*).

- Legislature designating a portion of the BSF that flows through the project area as a Kentucky Wild River (designation for River Mile 55.2 to River Mile 45.5) [Kentucky Revised Statutes (KRS) 146.200 – 146.350].

- Endangered Species Act. Presently, no federally-listed species are known to occur in the project area; however, six federally-listed mussels have been documented within the BISO (NPS 2000), and two listed plants may occur proximal to the project areas.

- Objectives stated in the BISO Water Resources Management Plan (see **Table 1-2**).

Streams in the BSF watershed generally contain sandstone beds that have poor buffering capacities and are particularly susceptible to CMD (*TDEC 1997*). As a result of CMD, many of the streambeds in the project area are coated with an iron precipitate known as “yellow boy”, which often interferes with the life cycle of aquatic organisms. In addition, pH levels and metal concentrations of CMD are often toxic to aquatic organisms. Due to these physical and chemical alterations resulting in CMD, many streams in the project area are devoid of aquatic life (*Rikard et al. 1986*).

The purpose of the proposed action is to limit and/or prevent, to the extent possible, CMD from further impacting tributary streams in the project area, and subsequently the BSF. It is proposed to abate the CMD problems in the project area through site reclamation and remediation techniques, by preventing and/or controlling the formation of CMD and/or by treating the CMD at its discharge point.

Table 1-2 Management Objectives of the BISO Water Resources Management Plan

Water Environments
- Preserve the BSF, major portions of the Clear Fork and New River, and portions of their various tributaries, as natural free-flowing streams.
- Restore and maintain natural aquatic, wetland, and riparian environments in which natural physical, chemical, and biological processes function with minimal interference.
- Allow natural hydrologic and geomorphic processes of floods to occur while minimizing risks of injury and property damage. Develop a management policy that is consistent with the National Park Service Floodplain Management Guidelines (NPS 1993).

Water Quality
- Maintain, and where needed, restore a high level of water quality to support natural ecosystem functioning and healthful water-based recreation.

Water Resources Inventory and Monitoring
- Maintain and enhance a water resources inventory and monitoring program that accurately reflects the condition of water resources, detects changes and impacts, and provides a useful basis for BISO management decisions. Attributes that represent the condition of water resources include habitat, biological, physical, and chemical parameters.
- Develop and maintain a regular data management and analysis program, including development of a Geographic Information System (GIS) database.

Mining
- Mitigate impacts of past coal mine activities to both surface and ground water.
- Ensure that permitted mineral exploration and development are accomplished with minimal impact to both surface and ground water.

Oil and Gas
- Mitigate impacts of past oil and gas activities to both surface and ground water.
- Ensure that oil and gas exploration and development are accomplished with minimal impact or risk to both surface and ground water.

Recreation Area Operations
- Ensure that BISO development and operations do not adversely affect BISO water resources and water-dependent environments.
- Ensure that all BISO activities comply with applicable federal and state laws and regulations.

Cooperative Management
- Maximize the use of cooperative relationships with federal, state, and local government agencies; universities; private organizations; and landowners to achieve the purpose of the BISO.

Public Education/Public Awareness
- Promote public awareness and understanding of the importance and function of water resources and their dependent environments.

Source: TDEC 1997

1.3 Scope of the EA

This EA provides descriptions of three possible alternatives as summarized below.

- Alternative 1: Preferred Action Alternative: Implement a series of environmental improvement actions throughout the affected sites, including the construction of ALDs, constructed wetland treatment systems, and lined channels within the project area.

- Alternative 2: Modified Action Alternative: Implement many of the same actions as included in the Preferred Action Alternative with a few variations. The differences between Alternatives 1 and 2 are primarily related to the method by which remediation is proposed at certain project sites.

- Alternative 3: No Action Alternative: Implement no actions to remediate sites adversely affected by CMD.

A detailed description of the proposed actions (associated with the Preferred Action Alternative) is provided in **Section 2.0**. Descriptions of Alternative 2 (the Modified Actions Alternative) and Alternative 3 (the No Action Alternative), as well as descriptions of alternatives eliminated from detailed study are provided in **Section 3.0**.

Section 4.0 of this EA analyzes the full breadth of potential environmental, cultural, and socioeconomic impacts to the environment and resources at and in the vicinity of the project area that could result from the proposed actions. Resource categories analyzed in the EA include: physical environment; land use; air quality; noise; geology, topography and soils; water resources and water quality; floodplains and wetlands; biological resources including terrestrial and aquatic communities, wildlife resources, and special status species; cultural resources; socioeconomics; public and occupational health and safety; protection of children; environmental justice; infrastructure; and hazardous and toxic materials/wastes.

1.4 Public Participation

As specified under NEPA and NEPA's implementing regulations promulgated by the CEQ and NPS-12, public participation is a significant component of the EA process. Intergovernmental and interagency coordination of environmental planning (IICEP) consultation letters were sent to a number of agencies and organizations during the preparation of this EA to identify relevant issues to be addressed in the EA. These letters and responses are included in **Appendix C**.

1.5 Related NEPA Reviews

A Watershed Plan/EA was prepared for the restoration and enhancement of the Bear Creek watershed, Scott County, Tennessee in 1997 by the NRCS. The document addresses the remediation of poor water quality through reclamation of abandoned mine lands and eroding forest lands within the Bear Creek Watershed. Economic, social, and environmental issues addressed in the plan/EA include (*NRCS 1997*):

- Water resources, including quality and supply;
- Fish and wildlife habitat;
- Cultural resources;
- Threatened and endangered species;
- Human health and safety;
- Economic development; and
- Air quality.

These issues as well as additional issues identified during the agency consultation process are addressed in this EA.

The BISO General Management Plan/EIS (presently in draft form) will address current resource conditions and explore various management alternatives. As discussed in **Section 1.1.5.1**, this plan will serve as a comprehensive framework for management in compliance with NPS policies and procedures. As required by NEPA, public review will serve an integral part in the further development and completion of this plan and management practices within the BISO.

1.6 Required Permits/Reviews

Implementation of the proposed project may potentially require securing the following permits:

- A **Clean Water Act (CWA) Section 404 permit** is required for discharges of dredged or fill materials into Waters of the United States. This permit may be required if remedial actions are proposed to occur in Waters of the U.S., including wetlands. Section 404 permits are obtained from the USACE. A **Section 401 Water Quality Certification** from the KDEP is required for USACE CWA permits.
- A **National Pollutant Discharge Elimination System (NPDES) permit** is required by the CWA for discharges of pollutants from any point source into waters of the U.S. A point source is defined as a discrete conveyance such as a pipe or man-made ditch. An NPDES permit may also be required for wetland discharges. Kentucky has a USEPA-approved NPDES permitting program. Kentucky Pollution Discharge Elimination System (KPDES)/NPDES permits are issued by the Kentucky Department of Environmental Protection (KDEP), Division of Water.
- A **KPDES permit for Stormwater Discharges** is required for stormwater discharges for construction projects disturbing greater than five acres of land. This permit may be required for some of the construction sites associated with this project. KPDES permits are issued through the KDEP Division of Water.
- A **Floodplain Construction permit** is required prior to the construction, reconstruction, relocation, or improvement of any dam, embankment, levee, dike, bridge, fill, or other obstruction across or along any stream or in the floodway of any stream; in designated 100-year floodplains; or in areas known to be flood prone. Some of the proposed wetland treatment systems would be located in flood-prone areas. This permit may be obtained through the KDEP, Division of Water.
- A **Wild Rivers Change of Use permit** may be required prior to undertaking any change of existing land use in a Wild River corridor. The BSF is considered a Kentucky Wild River from the Kentucky/Tennessee line to approximately Devil's Jump. Blair Creek, Blue Heron, and Laurel Branch project sites lie along this portion of the BSF corridor. This permit may be obtained through the KDEP Division of Water. However, at this time, no specific change in use is expected, as the proposed remedial activities likely will continue to fall within the BISO 's current land use designation(s).
- In compliance with **Section 106 of the National Historic Preservation Act (NHPA)**, the NPS will be required to obtain a letter of concurrence with respect to the proposed project activities from the Kentucky Heritage Council and the State Historic Preservation Office (SHPO) prior to project implementation. Phase I cultural reconnaissance surveys may be required in order to receive such concurrence.

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2.0 Description of the Proposed Actions

2.1 Introduction

The NPS proposes to mitigate CMD and/or prevent the production of CMD at eight sites within the Kentucky portion of the BISO using grading and revegetation, passive treatment systems (i.e., ALDs and constructed wetlands, polishing ponds), and/or water source controls (i.e., lined channels, regrading) to prevent surface water from contacting mine spoils. This section describes the proposed actions, which total approximately 22 acres of disturbance, as desired by the NPS. The project sites proposed for remediation are as follows:

- Laurel Branch;
- Devils Creek;
- Blue Heron Spoils;
- Blair Creek;
- Worley Mine #88;
- Worley Mine #86;
- Slavey Hollow; and
- Nancy Graves.

The systems are designed to have relatively few maintenance costs and operate with minimal human intervention. However, periodic maintenance will be required. Therefore, the proposed project includes creating and in some cases maintaining permanent access to these project sites. **Figure 1-3** identifies project sites and access routes for the proposed actions. Descriptions of the proposed actions and access routes are provided in the following sections.

2.2 Laurel Branch

2.2.1 Laurel Branch Stream Spoils

Laurel Branch is located on the eastern side of the BSF in the southern portion of the project area (see **Figure 1-3**). Historic mining operations in this drainage basin left spoil piles along side slopes and within the stream channel. As a result, approximately 100 feet of Laurel Branch is impacted by partially pyrolyzed spoil piles. In addition, the area upstream of the spoil piles is filled with permeable alluvial deposits, which provides a good recharge area for the toxic spoils.

Water quality of this stream deteriorates as it flows through the mine spoils. Below the spoil piles, the stream exhibits depressed pHs, increased acidity, and increased metal concentrations during low flows, while upstream water quality parameters reflect the absence of CMD impacts (*Gannett Fleming, Inc. 1998*).

As shown in **Figure 1-3**, the Blair Creek Loop horse trail traverses the Laurel Branch Stream Spoils site and crosses Laurel Branch within the project site.

The following actions are proposed at this site (see **Figure 2-1**):

- Install culverts (100-yr 6-hr storm design) at the existing stream grade to convey surface water through the mine spoils, preventing contact. The fill above the culverts would consist of any excavated spoils stored out of contact with the stream channel. The culverts would extend approximately 120 feet along the stream channel presently impacted by mine spoils. The culverts would segregate the uncontaminated stream from the partially pyrolyzed spoils.

- Install a high-density polyethylene (HDPE) liner through the upstream area of permeable alluvial deposits to prevent recharge of the toxic spoils and seepage into the stream; **—or—** Construct a cut-off trench at the upstream end of the spoil pile. The trench would be excavated to bedrock along the interface between the alluvium and pyrolyzed spoils. The trench would then be backfilled with a liner, bentonite slurry, or other impermeable material; or a grout curtain would be installed.
- Reroute horse trail over culverts and out of creek.

Maintenance of the system would involve periodically cleaning out the culverts. As shown on **Figure 1-3**, access to this site for construction and follow-up maintenance would be accomplished via the Blair Creek Loop horse trail (see **Section 2.10**). No heavy equipment would likely be needed during routine maintenance activities.

2.2.2 Laurel Branch Confluence

This site is located approximately 800 feet downstream (north) of the confluence of Laurel Branch and the BSF (see **Figure 1-3**). This site consists of approximately one to two acres of partially re-vegetated spoils. The spoils extend steeply up from the east bank of the BSF at near-vertical slopes. These slopes have been cut away by erosional forces during river high flows. The base of the spoil pile contains partially pyrolyzed spoil below loose material. The tops of the spoils are slightly higher than the alluvial terraces along the river, which are visible near the southern limits of the site. From the crest, the spoils extend at a slight grade to the hillside, which is covered with spoil but is well vegetated. CMD seeps flowing directly into the BSF occur at the base of these spoil piles.

The following actions are proposed at this site (see **Figure 2-2**):

- Regrade approximately two acres of spoil material adjacent to the BSF. Following regrading of the main spoil pile immediately adjacent to the BSF, spoil material from the steep upslope section would be pushed downhill to the main spoil area where it would be compacted in small lifts. The upslope spoils would be lowered until the capacity of the lower area was met. A bench would be created at the top of the new fill approximately 30-40 feet below a natural bluff extending from the edge of the spoil into natural ground.
- Incorporate lime into each lift during regrading to help neutralize the potentially acid-forming spoils and add alkalinity to any water contacting the spoils.
- Construct an HDPE-lined interceptor channel at the eastern edge of the bench along the steeply sloped hillside to convey surface runoff away from spoil. The lined interceptor channel would convey water directly to the BSF. This interceptor channel would help prevent surface runoff from entering the pyrolyzed spoil adjacent to the BSF.
- Cover the disturbed areas with available amended soil and revegetate.
- Install piezometers in the re-graded spoils to monitor ground water quality and quantity in the spoils. The information from the monitoring would be used to determine future actions to the site.

Maintenance of the system would involve the aforementioned monitoring and possibly remedial revegetation and grading in the 2 to 3 years immediately following construction. No heavy equipment would likely be needed during routine maintenance activities.

As shown on **Figure 1-3**, access to this site would be accomplished via the Blair Creek Loop horse trail and the River Trail (see **Section 2.10**).

2.3 Devils Creek

Devils Creek is located on the western side of the BSF just north of the trestle located at Blue Heron (see **Figure 1-3**). CMD enters Devils Creek from diffuse discharge points along the steep spoil-covered side slopes on the northern side of the creek. The mine entries contributing to these diffuse discharge points have been sealed and the actual elevation of the entries is unknown but reported to be below the mine tramway at this location. The steep slopes and water from the entries have caused a slope failure in the spoils below the tramway extending to the creek level. The diffuse discharge points are located in an approximately one-acre area approximately 40-50 feet below the tramway.

The following actions are proposed at this site (see **Figure 2-3**).

- Construct a water collection system to intercept mine water as close to the mine entrances as possible.

- Construct an ALD and an aerobic treatment system consisting of a settling pond (approximately ¾ acre) and polishing pond (approximately ¾ acre). These cells would be constructed on an upper terrace of the BSF on the north side of Devils Creek. Discharge from the polishing unit would enter Devils Creek.

The settling pond in which iron precipitate would accumulate would be likely dredged periodically (approximately every 20 to 30 years). This material would be disposed off-site. In addition it would be necessary to replace or maintain the limestone in the ALD every 15 to 20 years. These proposed actions are subject to further study of Devils Creek.

As shown in **Figure 1-3**, access to the Devils Creek Site would be accomplished via the Wilson Ridge Road and primarily pre-existing, unimproved trails and/or mining roads (see **Section 2.10**).

2.4 Blue Heron Spoils

The Blue Heron Spoils site is located on the eastern side of the BSF approximately ¾ mile upstream (south) of the Blue Heron trestle and parking area (see **Figure 1-3**). This site is approximately 10 acres in size and is located directly adjacent to the BSF. For descriptive purposes, the site may be divided into three distinct areas: Blue Heron North, Blue Heron South, and Pine Plantings area.

The North area is approximately 3.5 acres in size and has well-established herbaceous vegetation. This area is down slope of at least three natural drainages, which may be recharging seeps near the river. There is also a sediment pond in the southwest corner of this area that was constructed during previous attempts to regrade the site. Previous regrading attempts reportedly covered up a spring in this vicinity (*Bakaletz, personal communication*).

The North area is separated from the South area by a 1.5-acre area of tree-covered spoils. Although poorly graded, these spoils appear to be relatively shallow based on the size and types of trees in this area.

The South area, which is approximately 3.5 acres in size, is covered with well-established herbaceous vegetation except near the riverbanks, where high water has cut the toe of the spoil pile, resulting in near-vertical slopes. The undercutting of the toe has resulted in this area being geotechnically unstable, as evidenced by a scarp approximately 150 feet back from the toe with a vertical displacement of up to 1.5 feet.

The Pine Plantings area is approximately 1.5 acres in size and has relatively mature scotch pine trees, minimal ground cover, and occasional bare areas throughout. The Pine Plantings area is bounded on the east by a diversion channel constructed during previous reclamation efforts. This channel is lined from a perennial spring near the elevation of the tramway with sluiced concrete. The lined portion extends from the tramway approximately 150 feet where the ditch continues in natural ground along the side slope and a spoil berm.

The following actions are proposed at this site (see **Figure 2-4**).

- Construct lined ditches along the northern limits of the site to divert surface waters from upslope areas. These diversion ditches would be broken into segments to take advantage of the natural slope of the land and would be constructed at the interface between the spoil and the upslope area and would convey relatively un-contaminated surface water around the spoil piles.

- Remove sediment pond in western portion of site and regrade area to encourage runoff (and discourage infiltration).

- Construct a cut-through lined ditch through the middle portion of the spoils. This lined ditch would convey surface waters through the spoil piles, preventing contact.

- Regrade steep slopes of spoil pile near the river bank in the South area to a 2H:1V slope to reduce the potential for further instability.

- Regrade approximately ½ acre of spoils in the eastern portion of the site within the Pine Plantings area to encourage runoff (and discourage infiltration).

- Extend the existing concrete lined channel on the eastern side of the site with a HDPE liner to prevent introduction of surface water conveyed by this channel into the spoils.

- Install piezometers in the re-graded spoils to monitor ground water quality and quantity in the spoils. The information from the monitoring would be used to determine future actions to the site.

Maintenance of the system would involve the aforementioned monitoring and possibly remedial revegetation and grading in the 2 to 3 years immediately following construction.

As shown in **Figure 1-3**, access to the Blue Heron Spoils Site would be accomplished via existing trails leading from the Blue Heron parking area (see **Section 2.10**).

2.5 Blair Creek

Blair Creek is located on the eastern side of the BSF in the southern portion of the project area (see **Figure 1-3**). Mine drainage enters the stream at several diffuse locations along both sides of Blair Creek, beginning where the coal seam crosses the stream channel and extending downstream approximately 700 feet. The side slopes of the stream channel, as well as the overall Blair Creek drainage, are extremely steep and consist of residuum and spoil from the tramway.

It is proposed to capture the mine water near the stream level and route CMD via a pipe to constructed wetland cells on a bench on the north side of Blair Creek (see **Figure 2-5**). These actions are described below.

- Horizontally drill into the underground mine at its lowest level near the level of the stream in an attempt to de-water the diffuse discharge points from the mine pool above the level of the stream, and subsequently convey the mine discharge via a pipe adjacent to the stream channel to treatment cells.

- Construct a two- to three- acre wetland treatment system on a bench on the north side of Blair Creek. CMD would be directed approximately 1500 feet via a pipe from the horizontal drill holes to the wetland treatment system consisting of a settling pond and polishing unit. An ALD would potentially be installed at the end of the pipe to add alkalinity to the CMD prior to entering the wetlands. Discharge from the wetland treatment system would enter directly into BSF.

- Grout portions of Blair Creek stream channel upstream of crop line where the channel is submerged and may be contributing un-impacted water to the mine

The settling pond in which iron precipitate would accumulate would likely need to be dredged periodically (approximately every 10 to 15 years). This material would be disposed off-site. Additionally, remedial revegetation and grading in the 2 to 3 years immediately following construction is anticipated. These proposed actions are subject to further study.

As shown in **Figure 1-3**, the Blair Creek site would be accessed from the Blair Creek Loop horse trail (see **Section 2.10**).

2.6 Worley Mine #88

Worley Mine #88 is located on the eastern side of the BSF approximately 1/3 mile south of the Worley Branch/BSF confluence (see **Figure 1-3**). The mine entry is located on the north side of an unnamed tributary to the BSF south of Worley Branch. The site consists of a single gated entry discharging through a weir. The area around the entry is small (less than ¼ acre) and there is no tramway road leading to the site at the seam elevation. The Mine #88 discharge flows from an open adit into a ditch directly to the BSF. This area lies immediately adjacent to the Big South Fork Scenic Railway.

The following actions are proposed at this site:

- Construct an anaerobic up-flow treatment system just above of the existing rail bed (see **Figure 2-6**). This constructed wetland would be approximately 50 feet by 50 feet wide and 16 feet deep. The western side of the treatment system would be bound by a 16-foot high wall, which would be camouflaged to the extent possible, in order to blend with the existing visual environment.

- Pipe the CMD from the mine adit approximately 200 feet to the constructed anaerobic up-flow wetland. Discharge from the treatment system would flow into a series of small sediment retention ponds or sediment ditches adjacent to the Big South Fork Scenic Railway to collect the precipitate. The discharge from these structures would be routed to the BSF.

As a result of space constraints, the precipitate detention structures likely would likely need to be maintained or cleaned out approximately every 6 months. Also, the organic substrate in the treatment system will likely need to be replenished every 2 to 3 years. The proposed actions for this site are subject to change based on further study of the site.

As shown in **Figure 1-3**, access to the Worley Mine #88 site would be accomplished via an existing, unimproved, public road and the railroad bed (see **Section 2.10**).

2.7 Worley Mine #86

Worley Mine #86 is located along Worley Branch on the eastern side of the BSF (see **Figure 1-3**). CMD is entering Worley Branch from a single entry discharging from a wet seal approximately 760 feet upstream of the Big South Fork Scenic Railway. Two other sealed entries with minor flows are located upstream of the primary discharging entry.

The proposed treatment site lies within the Worley Branch drainage basin. This area was historically utilized as a mine services area for the local mines and contains numerous remnants of the structures that were previously utilized. These include the aforementioned mine entries, a building foundation, several excavation areas, the roadway accessing the site, and a concrete flume in the ditch that feeds to a concrete box culvert. The site is bounded on the south by the access roadway, a minimally maintained public road.

It is proposed to install an ALD and construct a wetland treatment system at this site (see **Figure 2-7** for a reference map of the site; proposed actions are not shown). The proposed treatment includes the following:

- Anoxically (below the surface of the water and without atmospheric interaction) collect CMD flowing from the mine adit prior to contact with the atmosphere and direct it into a 1,500-ton capacity ALD approximately 150 feet long (25-year design).
- Direct CMD from the ALD into an approximately 1/3-acre settling pond, followed by a 1/3-acre constructed aerobic wetland. These two aerobic cells would be constructed within the Worley Branch drainage basin. This constructed wetland treatment system would stretch approximately 600 feet from the ALD to just above the existing Big South Fork Scenic Railway. Treated discharge water from the wetland would be piped beneath the railroad bed to the BSF.
- Route the upstream, un-impacted Worley Branch flow through approximately 600-foot long culverts beneath the constructed wetland treatment cells. This flow would then discharge through the existing culvert beneath the railroad bed.
- Improve the public access road to the site and subsequently to the main body BSF channel. As mandated in the BISO Charter, this road would be permanently maintained for public access to the BSF.

The settling pond would likely need to be periodically dredged (approximately every 10 to 15 years) to remove iron precipitate. This material would be disposed off-site. Additionally, remedial revegetation and grading in the 2 to 3 years immediately following construction is anticipated.

As shown in **Figure 1-3**, access to the Worley Mine #86 site would be accomplished via an existing, unimproved, public road (see **Section 2.10**).

2.8 Slavey Hollow

Slavey Hollow is located on the western side of the BSF in the northern portion of the project area (see **Figure 1-3**). The mine entry associated with this site is located approximately 1,000 feet upstream of the Slavey Hollow/BSF confluence, on the south side of the stream. The single mine entry is currently discharging through a wet seal via an 18-inch corrugated plastic pipe. The side slopes of the stream channel and overall drainage are extremely steep and contain many bluffs with vertical slopes. Except during storm events, the flow in Slavey Hollow is sustained solely by the mine discharge.

The following actions are proposed at this site:

- Intercept the discharge from the existing 18-inch pipe, routing it through an HDPE pipe along the south side of the drainage to the proposed treatment cells located on the BSF floodplain.

- Construct a two-celled aerobic treatment system on the BSF floodplain (see **Figure 2-8**). CMD would be collected at the mine entry and piped approximately 1000 feet to the treatment system. The first cell would consist of a ½ -acre settling pond and the second cell would consist of ½-acre polishing unit (i.e., cattail wetland). Discharge from the polishing unit would flow directly into the BSF.

The settling ponds would likely need to be periodically dredged (approximately every 20 to 30 years) to remove iron precipitate. This material would be disposed off-site. Additionally, remedial revegetation and grading in the 2 to 3 years immediately following construction is anticipated.

As shown in **Figure 1-3**, access to the Slavey Hollow site would be accomplished via the Kentucky Trail and Wilson Ridge Road (see **Section 2.10**).

2.9 Nancy Graves

Nancy Graves Creek is located on the western side of the BSF in the central portion of the project area (see **Figure 1-3**). Approximately 200 feet upstream of the Nancy Graves confluence with the BSF, mine spoils extend from the creek banks upslope 70-80 feet to the coal seam level, as indicated by the existing historic mining tramway. The stream flows subsurface above the tramway, where large amounts of spoil were placed in the drainage. A ravine which conveys this water once it re-emerges has developed below the tramway, and subsequently merges with the natural, pre-mining stream channel approximately 200 feet downstream. The stream emerges at the base of a spoil pile as a seep near this location.

The following actions are proposed at this site (see **Figure 2-9**):

- Construct a HDPE-lined stream channel to reroute the stream from the location above the tramway where it enters the subsurface to the natural stream channel below the mine spoils. This would prevent the stream from flowing subsurface and coming in contact with mine spoils.

Nancy Graves Creek is also being impacted on the south side of the creek by CMD coming from a 1000 square-foot seepage zone located between an area lateral to the aforementioned seep south to an existing powerline right-of-way. The seepage appears to flow directly to both the BSF and Nancy Graves Creek.

It is proposed to (see **Figure 2-9**):

- Construct a cut-off trench system to collect discharge from the powerline seeps.

- Construct an approximately two-acre wetland treatment system on BSF floodplain on the north side of the creek. CMD would be piped from the cut-off trench to the wetland treatment cells. Treated water from the wetland cells would flow directly into the BSF.

The settling pond would likely need to be periodically dredged (approximately every 20 to 30 years) to remove iron precipitate. This material would be disposed off-site. Additionally, remedial revegetation and grading in the 2 to 3 years immediately following construction is anticipated.

As shown on **Figure 1-3**, access to the Nancy Graves site would be accomplished via primarily pre-existing, unimproved trails and/or mining roads from the Wilson Ridge Road (see **Section 2.10**).

2.10 Access Routes

The sites proposed for CMD remediation are relatively remote with few existing improved roads available for access. As shown in **Figure 1-3**, the proposed actions would require maintaining and/or re-opening five primary access routes leading to project sites. These access routes are primarily sited along existing trails and/or former mining/timber roads.

The Laurel Branch Sites and the Blair Creek Site would be accessed from the Blair Creek Loop Horse Trail. The Blair Creek Horse Trail would be accessed from an unimproved road off the Kentucky 742. Approximately 1.5 miles of the Blair Creek Loop would likely be temporarily impacted during remediation construction activities. The horse trail would be widened to approximately 20 feet to allow equipment access to the Blair Creek and Laurel Branch sites. Following construction, permanent erosion control measures would be installed on the horse trail, and it would be revegetated to the extent practicable. Access for minor maintenance of the remedial systems at the Laurel Branch and Blair Creek sites likely would be required approximately every 2 to 3 years.

Access to the Worley Mine #86 site would be accomplished via an existing, unimproved, public road. From the Worley Mine #86 site, the Worley Mine #88 site would be accessed along the Big South Fork Scenic Railway right-of-way. The unimproved road leading to the Worley Mine #86 site would be widened to approximately 20 feet and permanently maintained following construction as an access point to the BSF.

Access to the Nancy Graves and Devils Creek sites would be accomplished via the existing Wilson Ridge Road and primarily pre-existing, unimproved trails and/or mining roads. For the purposes of bringing equipment to the site, trails would be widened to approximately 20 feet. Following construction, permanent erosion control measures would be installed, and the trails would be revegetated at the discretion of the NPS. For maintenance purposes these sites would have to be accessed approximately every 15 to 30 years.

The Blue Heron Spoils site would be accessed from the Blue Heron parking area via existing trails. The existing trails would be widened to approximately 20 feet to allow construction equipment access to the site. Following construction, permanent erosion control measures would be installed on these access roads, and they would be revegetated at the discretion of the NPS. A need for continued access to this site is not anticipated.

The Slavey Hollow site would be accessed from Wilson Ridge Road via pre-existing unimproved trails and/or mining roads. Based on current iron loading calculations, maintenance of the treatment system at Slavey Hollow would not be required for approximately 80 years; however, the access road would be maintained on an as-needed basis.

3.0 Alternatives Considered

NEPA, CEQ regulations, and NPS-12 require that all reasonable alternatives be rigorously explored and objectively evaluated. Alternatives that are eliminated from detailed study must be identified along with a brief discussion of the reasons for eliminating them.

This section identifies Alternatives that were considered by the NPS for the remediation of the selected contaminated mine drainages. **Table 3-1** summarizes the primary alternatives that are considered in this EA. Alternative 1, implementation of the proposed actions identified in **Section 2.0**, has been determined by the NPS to be the Preferred Alternative. Alternative 2, implementation of a Modified Actions Alternative, which implements some, but not all, of the projects identified as the Preferred Alternative, is retained for evaluation in this EA. As required under NEPA, CEQ regulations, and NPS-12, the No Action Alternative (Alternative 3) is also retained in this EA for comparative analysis.

3.1 Alternative 1: Preferred Action Alternative

Under this alternative, the proposed actions listed in **Table 3-1** would be implemented as described in **Section 2.0**. Alternative 1 is the Preferred Alternative because it provides sound, economically- and environmentally-feasible remedial actions that would help prevent further CMD impacts to surface waters entering the BSF.

3.2 Alternative 2: Modified Action Alternative

As shown in **Table 3-1**, Alternative 2 includes many of the same site-specific actions as the Preferred Action Alternative. Differences between these alternative actions include those at Laurel Branch Stream Spoils, Laurel Branch Confluence, Devils Creek, Slavey Hollow, and Nancy Graves. Access roads for Alternative 2 are identical to those of Alternative 1. Site specific variances of Alternative 2 are described in the following sections.

3.2.1 Laurel Branch Stream Spoils

Under Alternative 2, the NPS would construct a lined stream channel (approximately 240 feet in length) through the mine spoils. As with Alternative 1, Alternative 2 would prevent the surface flow from contacting acidic-producing materials in the spoil. Culverts would not be installed under this alternative.

3.2.2 Laurel Branch Confluence

Under Alternative 2, spoil piles below the existing hiking trails would be regraded and a lined interceptor channel would be constructed to intercept surface water from upslope areas. Under this alternative, a smaller area would be regraded than under Alternative 1, and the lined channel would be located at a lower elevation than what is proposed under Alternative 1.

3.2.3 Devils Creek

Under Alternative 2, the NPS would construct a lined ditch to capture seepage from mine adits and convey discharge to a series of anaerobic wetlands (three cells). The wetlands would be located on the same bench as specified in Alternative 1. Discharge from this wetland system would flow into Devils Creek.

Table 3-1 Summary of Site-specific Actions for Each Alternative

Project Site	Alternative 1: Preferred Action Alternative	Alternative 2: Modified Action Alternative	Alternative 3: No Action Alternative
Laurel Branch Stream Spoils	Install culverts to segregate stream from mine spoils, and line upstream area of permeable alluvial deposits or construct cut-off trench at upstream end of spoil pile.	Construct lined channel to segregate stream from mine spoils.	Allow stream to continue flowing through mine spoils, resulting in CMD to the BSF.
Laurel Branch Confluence	Regrade spoil area and construct an interceptor channel at the edge of spoil to convey surface runoff away from spoil.	Regrade a portion of the spoil area and construct a lined interceptor channel.	Allow runoff to continue to drain through mine spoils, resulting in CMD to the BSF.
Devils Creek	Intercept mine waters and construct an ALD and a two-celled aerobic treatment system.	Intercept mine waters and construct a three-celled aerobic treatment system.	Allow CMD to continue flowing into Devils Creek via diffuse discharge points.
Blue Heron Spoils	Regrade selected areas, divert surface waters from mine spoils via lined ditches, and remove sediment pond.	Same as Alternative 1	Allow mine spoils to continue affecting surface waters.
Blair Creek	Construct treatment system on floodplain, drill into mine at stream level, and pipe CMD to constructed wetland on floodplain. Grout portions of creek upstream of the crop line.	Same as Alternative 1	Allow CMD to continue to enter Blair Creek
Worley Mine #88	Construct anaerobic up-flow wetland and pipe CMD from mine adit to wetland. Construct small sediment settling ponds adjacent to rail bed.	Seal mine entry at Mine # 88, which would potentially direct water to Mine #86 treatment system.	Allow CMD to continue to flow from mine opening to Big South Fork.
Worley Mine #86	Install ALD and construct wetland treatment system in Worley Branch drainage basin.	Same as Alternative 1	Allow contaminated discharge from Mine 86 to continue entering Worley Branch.
Slavey Hollow	Construct wetland treatment system on floodplain and pipe CMD to wetland from mine portal.	Construct wetland treatment system on floodplain, dam stream, and divert stream water into treatment wetland.	Allow CMD to flow into Slavey Hollow stream.
Nancy Graves	Redirect stream and construct lined stream channel to direct water away from spoil piles; and construct wetland treatment system on BSF floodplain and pipe CMD from powerline seeps to wetland.	Redirect stream and construct lined stream channel to direct water away from spoil piles.	Allow stream to continue flowing through mine spoils and allow contaminated seeps (impacted by CMD) to enter stream.

3.2.4 Slavey Hollow

Under Alternative 2, the mine drainage would not be collected at the mine discharge, but rather downstream, near the location of the proposed treatment wetlands. A cofferdam would be constructed across the stream channel and discharge would be diverted into the treatment wetlands. During rain events, additional discharge would bypass wetlands and flow directly into the BSF.

3.2.5 Nancy Graves

Under Alternative 2, the NPS would construct the lined stream channel as described in **Section 2.2.9**; however no remedial actions in association with the powerline seeps would occur

3.2.6 Mine # 88

Under Alternative 2, the mine entry at this location would be sealed forcing the water to flow to the connected entries at Mine #86. This would increase discharge at Mine #86 and consequently the size of the treatment system at Mine #86.

3.3 Alternative 3: No Action Alternative

As discussed in **Section 1.2**, water quality of tributary streams in the project area is presently very poor. Under this alternative, no remedial actions would be implemented to improve water quality of the tributary streams located in the project area. If the No Action Alternative is chosen, CMD in the project area would continue for decades to contribute to poor water quality of tributary streams, surface waters, and subsequently the BSF. Implementation of this alternative would allow mine spoils to continue to contaminated the BSF and its tributary streams in the project area.

3.4 Actions/Alternatives Eliminated from Detailed Study

As discussed in **Section 1.1.1**, there are many options available to address the abatement of CMD; however, conditions of a particular site may or may not be suitable for various remediation options. Subsurface injection, bacterial inhibitor application, and chemical treatment were eliminated from detailed study due to site suitability considerations, cost, and maintenance requirements.

In addition, the following site-specific remedial actions were eliminated from detailed study:

- Addition of limestone sand to the overall Blair Creek drainage, in hopes that precipitation would carry the sand into the drainage, therefore increasing the overall pH neutralization potential; and
- Experimental injection of an organic and limestone mixture into the Mine # 88 entry.
- Spoil removal from Laurel Branch Channel, Laurel Branch Confluence, Blue Heron Spoils, and/or Nancy Graves sites.

Addition of limestone sand to the Blair Creek drainage was eliminated as a practical alternative because it would not be effective in improving the overall water quality of Blair Creek. Based on water quality parameters of Blair Creek, the addition of limestone sand would not add enough alkalinity to the stream to significantly improve water quality or the aquatic environment. In addition, other unintentional peripheral effects such as iron precipitates might be encountered that would adversely affect water quality and the aquatic and terrestrial environments. As such, this alternative was dropped from further analysis.

Experimental injection of an organic and limestone mixture into the entry of Mine # 88 is not a feasible alternative. Based on initial calculations, the mixture would have to reach approximately 110 feet horizontally into the mine. This would require an increase in head pressure of approximately 160+ feet, which would have unknown consequences to the hydrology of the area. Therefore, this alternative was dropped from further analysis.

Direct removal of mine spoil materials was eliminated from detailed study primarily due to logistical infeasibility (very large amounts of material would likely need to be removed, resulting in the need for greatly improved access to each proposed remediation site, potential costs, and disposal issues, including the potential classification of removed materials as hazardous wastes.

3.5 Comparison of Alternatives

The environmental consequences of the three project alternatives are analyzed in this EA (see **Section 5**). In general, Alternatives 1 and 2 would potentially have *short-term negative impacts* associated with vegetation removal and construction activities but would have *long-term positive impacts* on water quality and aquatic ecosystems in the project area. Adoption of Alternative 3 would have *long-term negative effects* on water quality and aquatic resources in the project area.

4.0 AFFECTED ENVIRONMENT

4.1 General Overview

This section describes current baseline conditions within the project area, with emphasis on those resources potentially impacted by the proposed project alternatives. **Section 5.0**, **Environmental Consequences**, identifies potential direct and indirect effects of the identified project alternatives on each of the issue areas presented in this section. **Section 5.0** also contains mitigative measures that, when implemented, would reduce the level of identified negative impacts.

4.2 Study Area Description

4.2.1 Geographic Setting

As discussed in **Section 1.1.2**, the BISO is located approximately 50 miles northwest of Knoxville, Tennessee and encompasses approximately 125,000 acres in portions of Fentress, Scott, Pickett, and Morgan Counties, Tennessee, and McCreary County, Kentucky (see **Figure 1-1**). The project sites are located within the BSF gorge along a 12-mile section of the river approximately five miles north of the Tennessee border in McCreary County, Kentucky (see **Figure 1-2**).

4.2.2 Landscape

In general, the focus of the BISO is the massive gorge of the BSF itself, which has many sheer bluffs at the gorge rim towering over wooded talus slopes, with the naturally fluctuating river tributaries below. The peripheral drainages, as well as the main BSF valley are dotted with huge boulders broken from the cliff faces above. Weathering processes have produced an impressive array of rock formations, including arches, mesas, chimneys, cracks, and rock shelters, while streams within the NRRA include stretches of fast, rugged whitewater and quiet pools. Previous to the existence of the NRRA, the State of Tennessee designated Twin Arches and the Honey Creek areas as State Natural Areas because of their unusual geological and other natural attributes (*NPS 2000*).

4.2.3 Area Climate

McCreary County has a temperate climate with moderately cold winters and warm and humid summers. Average summer temperatures range from approximately 70 degrees Fahrenheit (°F) to 73 °F, while average winter temperatures range from approximately 32 °F to 37 °F. Temperatures vary with relief; average monthly temperatures are generally higher at lower elevations. Rainfall is fairly uniform throughout the year with September and October having slightly less precipitation. Intense thunderstorms of short duration generally occur from March through August. Light rainfall lasting for several days may occur in late spring and has the potential to cause significant flooding since soil is often saturated, frozen, or covered with snow during this time of the year. Average annual snowfall is approximately 10-14 inches, depending on relief. Long periods of mild, sunny weather generally occur in fall (USDA 1964). Climate data for Stearns, Kentucky, which is located approximately five miles from the BISO study area, is presented in **Table 4-1**.

Table 4-1 Average Rainfall and Temperatures for Stearns, Kentucky (1961-1990)

Month	Average Rainfall (inches)	Average Minimum Temp. (°F)	Average Maximum Temp. (°F)	Average Temp. (°F)
January	3.7	21.9	43.0	32.4
February	4.3	24.4	46.6	35.4
March	4.9	32.9	57.9	45.5
April	4.2	40.6	68.0	54.3
May	4.7	48.9	75.6	62.2
June	4.6	57.0	82.4	69.8
July	5.0	61.7	85.5	73.6
August	3.6	60.3	84.7	72.5
September	3.3	53.8	78.8	66.2
October	2.7	41.9	68.0	55.0
November	3.6	34.7	57.6	46.0
December	4.3	26.4	46.9	36.7
Year	48.6	42.1	66.2	54.1

Source: WorldClimate, 2001 (http://www.worldclimate.com/)

4.3 Land Use

Land use includes natural conditions or human-modified conditions and activities occurring at a particular location. Human-modified land use categories include residential, commercial, industrial, transportation, communications and utilities, agricultural, institutional, recreational, and other developed use areas. Management plans and zoning regulations determine the type and extent of land use allowable in specific areas and are often intended to protect specially designated or environmentally sensitive areas.

4.3.1 Land Cover

As discussed in **Section 1.1.3**, the BSF region has been extensively mined for coal since the turn of the century with some mines still operating in the BSF watershed. These mining activities created at least 120 underground entries within the BISO that are clustered along the various coal seams outcropping from the steep slopes of the BSF gorge. Remnants of mining facilities, railroad spurs, mine entries, haul roads and spoil piles are common throughout the project area and occur within project sites. Today, the project sites are primarily forested by secondary and tertiary-growth forest stands. Dominant vegetation at each project site is discussed in more detail in **Section 4.8**.

4.3.2 Aesthetics and Visual Resources

Visual resources are defined as the natural and manufactured features that comprise the aesthetic qualities of an area. These features form the overall impression that an observer receives of an area or its landscape character. Land forms, water surfaces, vegetation, and manufactured features are considered characteristic of an area if they are inherent to the structure and function of the landscape.

The project area is located entirely within the BISO and is used for outdoor recreational purposes such as hiking, horseback riding, hunting and fishing, and numerous other outdoor activities. The portion of the BISO in which the project sites are located includes a mixture of spectacular natural features (i.e., topographic relief, flowing river, mesic coves) and remnant coal mining features (i.e., building foundations, mine portals, spoil piles). Additional general landscape information is included in **Section 4.2.2**.

4.3.3 Local Communities

Counties surrounding the BISO contain scattered, low-density rural development with no major urban areas. McCreary County has a total population of approximately 17,080 (*U.S. Census Bureau 2000*). The largest of the local communities is Oneida, TN, which has a population of approximately 3,615 (*U.S. Census Bureau 2000*). The closest large city is Knoxville, TN (population 173,890), which is approximately 70 highway miles to the south and east of the BISO.

4.3.4 Site-Specific Land Use

As discussed in **Section 1.1.4**, the BISO, as managed by the NPS, was established to protect the BSF, preserve historic and natural features, and provide for outdoor recreation for the public. Land use within the BISO includes abandoned coal mines, roads and trails, the Oneida and Western (O & W) Railroad right-of-way, Oil and Gas sites, mineral ownership, inholdings (privately owned land within the boundaries of the BISO), recreation area facilities, agricultural leases, Scott State Forest, the Kentucky and Tennessee (K & T) Railroad right-of-way, gas pipelines, a Tennessee Valley Authority powerline right-of-way, and USACE flowage easements on Lake Cumberland. Land uses within or in the vicinity of the project areas (or access areas) that could potentially be impacted by the proposed project include: abandoned coal mines; roads and trails; recreation area facilities; and the K & T Railroad right-of-way; these are discussed below.

- **Abandoned coal mines** occur throughout the project area. Specifically, flow from abandoned coal mine openings directly contribute CMD to three (Worley Mine # 88, Worley Mine # 86, and Slavey Hollow) of the eight contaminated drainages included in this project. Other project sites are primarily impacted by pyrolyzed spoil piles.

- **Roads and trails** used by cars, trucks, hikers, mountain bikes, horses, and ATVs occur throughout the project area (see **Figure 1-3**). The Kentucky Trail is a hiking trail that extends from Wilson Ridge Road (in the vicinity of Slavey Hollow) south along and within the gorge passing Nancy Graves Creek, Devils Creek, and Three West Hollow Creek. As discussed in **Section 2.10**, portions of this trail are proposed to access the Slavey Hollow, Nancy Graves, and Devils Creek sites.

  The Blair Creek Loop Horse Trail extends from the Bear Creek Horse Camp, towards the BSF, across Blair Creek and Laurel Branch, and back towards the Bear Creek Horse Camp. As discussed in **Section 2.10**, use of this trail is proposed to access the Laurel Branch and Blair Creek sites.

  The River Trail meanders along the BSF. Portions of this trail are designated for both hiking and horseback riding. As discussed in **Section 2.10**, a portion of the River Trail is proposed for use as an access route for the Blue Heron Spoils area.

- **Recreation area facilities** within the vicinity of project sites or access routes include the Blue Heron historic area and the river access point at Worley.

  The Blue Heron mining community and the original narrow-gauge railroad, which are within the general project area, have been restored by the NPS and the reconstructed Blue Heron mining camp and interpretive center is a popular attraction for BISO visitors. The Blue Heron mine spoils site is proposed to be accessed from the parking area associated with the historic mining community and interpretive center.

An existing, poorly maintained public road (which is proposed be used to access the Worley Mine #86 and #88 sites) is designated as an official public access point to the BSF. This road presently passes through the Worley Mine # 86 project site.

- **K & T Railroad right-of-way** includes 47.6 acres along approximately four miles of track from Barthell on Roaring Paunch Creek north along the BSF towards Yamacraw. The owners of the K & T Railroad operate the Big South Fork Scenic Railway. This right-of-way is adjacent to the Worley Mine # 86 and #88 sites. Portions of the K & T right-of-way would potentially be used to access these sites.

4.3.5 Property Status

The project sites are wholly within the BISO, which is owned and operated by the NPS. Proposed access routes are sited along public roads and/or NPS property.

4.4 Air Quality

4.4.1 Regulatory Framework

The U.S. Environmental Protection Agency (USEPA) is the overall regulatory agency for air quality throughout the U.S. However, in most cases control is delegated to individual states. In some cases, the individual states may subsequently delegate control to local air quality management agencies. The primary regulatory authority for air quality in Kentucky is the KDEP, Division of Air Quality. Applicable regulations are set forth in Kentucky Administrative Regulations (KAR) Title 401 (401 KAR).

Federal air quality regulations are provided in the Clean Air Act (CAA) and the Clean Air Act Amendments of 1990 (CAAA). These regulations provide a comprehensive national program with the collective goal of reducing the levels of pollutants in the ambient air.

4.4.2 Ambient Air Quality

The ambient air quality in an area can be characterized in terms of whether it complies with the primary and secondary National Ambient Air Quality Standards (NAAQS). The CAAA requires USEPA to set NAAQS for pollutants considered harmful to public health and the environment. NAAQS are provided for seven principle pollutants, called criteria pollutants (as listed under Section 108 of the CAA), including the following:

- Carbon monoxide (CO);
- Lead (Pb);
- Nitrogen dioxide (NO_2);
- Ozone (O_3);
- Particulate matter with an aerodynamic size less than or equal to 10 micrometers (PM-10);
- Particulate matter with an aerodynamic size less than or equal to 2.5 micrometers (PM-2.5); and
- Sulfur dioxide (SO_2).

These pollutants are believed to be detrimental to public health and the environment, and are known to cause property damage. National primary and secondary ambient air quality standards have been established for each criteria pollutant. Primary standards are defined as "levels of air quality which USEPA judges are necessary, with an adequate margin of safety, to protect the public health." Secondary standards are defined as levels of air quality which USEPA judges are necessary to protect the public welfare from any known or anticipated adverse effect of a pollutant." [*KDEP (http://www.nr.state.ky.us/nrepc/dep/daq/airmonitoring.html)*].

4.4.3 Criteria for Attainment/Nonattainment Areas

Areas are designated as "attainment", "nonattainment", "maintenance", or "unclassified" with respect to the NAAQS. General air quality monitoring is conducted in areas of high population density and near major sources of air pollutant emissions. Rural areas are typically not considered in such monitoring. Regions that are in compliance with the standards are designated as attainment areas. Areas for which no monitoring data is available are designated as unclassified, and are by default considered to be in attainment of the NAAQS. In areas where the applicable NAAQS are not being met, a nonattainment status is designated (*USEPA 1999*).

McCreary County is currently classified by the USEPA as being in attainment for all criteria pollutants. Kentucky operates an air-quality monitoring network that includes 143 monitors in 31 counties. Monitoring stations are primarily located near populous areas or pollutant sources. The closest air monitoring station is located in Middlesboro in Bell County. Although there are no monitoring stations located in McCreary County, there are no immediately apparent air pollution sources located within the project area. [*USEPA 2001 (http://www.epa.gov/airs/nonattn.html)*; *KDEP (http://www.nr.state.ky.us/nrepc/dep/daq/airmonitoring.html)*].

4.4.4 Existing Emission Sources and Air Pollution Permits

There are no permitted emission sources within the project area. As defined by 401 KAR 50:035, there are numerous emission sources that are considered "trivial" and are exempt from permitting by the Kentucky Division for Air Quality. Emissions occurring in the immediate vicinity of the project sites are restricted to emissions from vehicles and road/trail dust, which are considered trivial sources or insignificant sources.

4.4.5 Proximate Sensitive Receptors

With regard to air quality, sensitive receptors include, but are not limited to, asthmatics, children, and the elderly, as well as specific facilities, such as long-term health care facilities, rehabilitation centers, convalescent centers, retirement homes, residences, schools, playgrounds, and childcare centers. These sensitive population segments and facilities correspond with those that the primary NAAQS propose to protect. With the exception of potential visitors to the BISO, there are no sensitive receptors within or in the vicinity of the project area; no permanently-located sensitive receptors reside in the immediate vicinity of the proposed project sites.

4.5 Noise

4.5.1 Regulatory Framework

Under NEPA, the Noise Control Act of 1972 (PL 92-574), and Executive Order (EO) 12088, the NPS is required to assess the environmental impact of noise produced by its activities. Within such an assessment, strategies are promulgated to protect both on- and off-site receptors from environmental noise.

4.5.2 Noise Sources

The noise environment within the project area includes primarily non-impulse noise generated from continuous low-energy noise sources, such as that produced by vehicles.

4.5.3 Proximate Sensitive Receptors

Sensitive receptors include, but are not limited to, health care facilities, rehabilitation centers, convalescent centers, retirement homes, residences, schools, playgrounds, and childcare centers. With the exception of potential visitors to the BISO, there are no sensitive receptors within or in the vicinity of the project area; no permanently-located sensitive receptors reside in the immediate vicinity of the proposed project sites.

4.6 Geology, Topography and Soils

4.6.1 Geology

The BISO is fully contained within the Cumberland Plateau physiographic province, which is the southern portion of the Appalachian Plateau structural province. This portion of the plateau is characterized primarily by horizontally-bedded sedimentary rocks of the Pennsylvanian and Mississippian Age. These rocks are predominately sandstone and shale but also include conglomerate, siltstone, and coal. A generalized stratigraphic column for the project area would include (in descending order) the Breathett Formation, Lee Formation, and the Pennington Formation.

The Breathett Formation is the youngest of the sedimentary rocks exposed in the project area. This formation is middle Pennsylvanian in age and extends over 170 feet thick in areas. This formation is composed primarily of shale, siltstone, and sandstone beds (*Pomerene 1964*).

The Lee Formation underlies the Breathett Formation and outcrops along the slopes of the BSF gorge. This formation is Lower Pennsylvanian in age and ranges from approximately 440 to 640 feet thick. The Lee Formation is composed of several members and beds including the Corbin Sandstone, Rockcastle Conglomerate, Beattyville Shale, and Barren Fork coal bed (*Pomerene 1964*).

The Pennington formation underlies the Lee Formation and is exposed within the inner gorge adjacent to the BSF. This formation is characterized by grayish-red or olive-green shale and contains thin-to medium-bedded sandstone and limestone. The Pennington Formation is upper Mississippian in age and extends over 200 feet thick. The Pennington is covered in some areas along the BSF by recent alluvium of silt, sand, gravel, and boulders (*Pomerene 1964*).

4.6.2 Mineral Resources

Mineral resources such as coal and oil and gas were historically extracted from the region; however, no mineral, petroleum, or gas development is presently permitted within the BISO.

4.6.3 Topography

The BISO includes relatively flat areas of the plateau as well as a deep gorge, created by the BSF and its tributaries. The main gorge is characterized by many sheer bluffs at the gorge rim and steep, talus slopes. There is little floodplain development along the BSF, and valleys within the gorge contain huge boulders broken from cliff faces above. Tributaries are generally characterized by steep densely-vegetated V-shaped gorges. Elevations range from approximately 740 feet above mean sea level (AMSL) along the BSF to approximately 1,250 feet AMSL on knolls at the edge of the river gorge. Project sites are located along the BSF floodplain, lower slopes of the gorge, and in deep V-shaped tributary valleys.

4.6.4 Soil Types and Characteristics

Soils in the project area are dominated by two major soil associations: Tate – Shelocta association and the Tate – Trappist association. The Tate – Shelocta association consists primarily of deep, well-drained, sloping to steep soils on benches and side slopes. The Tate – Trappist association consists of deep to moderately deep, well-drained, strongly sloping to steep soils on ridge tops and long stony side slopes along narrow drainage ways (*USDA 1964*).

The following soils are found within the project area:

- **Pope fine sandy loam, 4 – 20 % slopes (PoD)**, occurs along the banks of large streams. This is a strongly-acid soil and commonly has fragments of coal throughout its depth. It is formed from acid sediment that washed from weathered sandstone and shale. Limitations of this soil include the hazard of sloughing and the annual deposition of material washed from coal mines. Small areas of Tate and Elk soils are mapped with this unit (*USDA 1964*).

- **Strip mines (St)** consist of areas where material has been removed from above a coal seam to allow open pit mining (*USDA 1964*).

- **Tate, Shelocta, and Muse stony soils, 12 – 35% slopes (ToE),** occupies benched landforms that have a concave appearance. These soils developed from acid colluvium that weathered from siltstone, sandstone, and shale. Stones cover 10-30% of the surface (*USDA 1964*).

- **Tate stony sandy loam, 30-50% slopes (TmF),** occupies concave side slopes below cliffs. This soil is sandier than most Tate soils and contains more course fragments. Stones and steep slopes limit the use of these soils (*USDA 1964*).

- **Tate very stony land complex (Tc)** occurs at the foot of sandstone cliffs and along drainage ways that have steep to very steep, concave side slopes. Slopes range from 20 - 65 % and are often 50-200 feet long. This complex includes equal areas of Tate soils and very stony areas characterized by sandstone boulders, some rock outcrops, and stones (*USDA 1964*).

No hydric soils are mapped within or in close proximity to the project sites; however it is possible that hydric inclusions occur within these sites.

4.6.5 Prime and Unique Farmlands

Prime Farmlands are monitored by the NRCS to ensure preservation of agricultural lands that are of statewide or local importance. Soils designated as prime farmland are capable of producing high yields of various crops when managed using modern farming methods. Designation of such lands is based on soil type present. There are no prime farmland soils within the project area.

4.7 Ground and Surface Water Resources

4.7.1 Regulatory Framework

Protection and management of water resources within the BISO is mandated by numerous laws, regulations, and guidance. Water resources management is governed by one of the following categories: specific federal legislature (i.e., legislature establishing the BISO); other federal legislature (i.e., CWA); state legislature (i.e., Tennessee Water Quality Control Act); and National Park Service guidelines. The primary federal and state regulations and guidelines that govern the management of water resources within the project area include the following:

- Endangered Species Act of 1973 (ESA; 16 USC § 1531 *et seq.*);
- EO 11988, Floodplain Management, 24 May 1977;
- EO 11989, Off-Road Vehicle Use;
- EO 11990, Protection of Wetlands, 24 May 1977;
- EO 12088, Federal Compliance with Pollution Control Standards, 13 October 1978;
- EOs 11644, Use of Off-Road Vehicles on Public Lands;
- Federal Water Pollution Control Act of 1972 (FWPCA), as amended by the CWA (33 USC §1251 *et seq.*);
- Fish and Wildlife Coordination Act (16 USC §661 *et seq.*);
- General Authorities Act of 1970 (16 USC §1a-5);
- Kentucky Division of Water Administrative Regulations (401 KAR);.
- Kentucky Revised Statutes (KRS), Chapter 224;
- Kentucky Wild Rivers Act (KRS 146.200-146.360);
- Land and Water Conservation Act of 1976 (16 USC §460)
- NEPA of 1969 (42 USC §4321 *et seq.*);
- National Park Service Organic Act (16 U.S.C. l, 2, 3, and 4), Establishment of the National Park Service;
- Non-Federal Oil and Gas Rights (36 CFR 9);
- PL 91-383, Sale of Park Water;
- PL 93-251, Establishment of the Big South Fork National River and Recreation Area;
- Redwood National Park Act of 1978 (16 USC §79a-79q);
- Safe Drinking Water Act of 1974 (SDWA; 42 USC §300f *et seq.*);
- Soil and Water Resources Conservation Act of 1977 (16 USC §2001); and
- Surface Mining Control and Reclamation Act of 1977 (30 USC §1201-1328).

Water resources within the project area are managed according to these and other applicable environmental laws and NPS regulations.

4.7.2 Surface Water and Watersheds

The project area lies within the South Fork Cumberland River watershed (U.S. Geological Survey [USGS] Cataloging Unit 05130104). This watershed includes the area drained from the headwaters of the BSF to its confluence with the Cumberland River. There are approximately 27 rivers and streams within this watershed, totaling approximately 1,906 total river miles. Land area within this watershed totals approximately 1,350 square miles, primarily located in Fentress and Scott Counties, Tennessee; and McCreary County, Kentucky [*USEPA 2001 (http://www.epa.gov/surf3/hucs/05130104/)*].

The project area is located along an approximately 12-mile stretch of the BSF in McCreary County. As shown in **Figure 1-2**, the major tributary of the BSF in the project area is Roaring Paunch Creek. Smaller tributaries of the BSF in the project area include Blair Creek, Laurel Branch, Three West Hollow, Devils Creek, Slavey Hollow, and Worley Branch. With the exception of Roaring Paunch Creek, these streams are primarily first- and second-order streams and are characterized by steep-sided V-shaped tributary valleys.

4.7.3 Water Quality

4.7.3.1 Regional Water Quality

Following the release of the President's Clean Water Action Plan in February 1998, the Kentucky Division of Water and the NRCS lead the development of a Unified Watershed Assessment for Kentucky. The Kentucky Department of Fish and Wildlife Resources and the U.S. Fish and Wildlife Service (USFWS) also provided input. In addition, other agencies and organizations (i.e., Federal Office of Surface Mining, Cumberland River Compact) and the public have participated. Under Section 305(b) of the CWA, the Kentucky Division of Water must compile and evaluate all existing and readily available water quality data for a comprehensive unified assessment for Kentucky. Stream segments listed as "impaired" in the 305(b) list comprise Kentucky's 303 (d) list of impaired waters. All streams included in Kentucky's 305 (b) list were included in the Unified Watershed Assessment.

As part of the Unified Watershed Assessment, large-scale watersheds (8-digit Hydrologic Units) were placed into one of the following categories.

- Category I - Watersheds in Need of Restoration: These watersheds do not now meet clean water or natural resource goals. To qualify as a Category I watershed, the watershed must meet both of the following criteria: (1) at least 15% of the stream miles have been monitored and assessed, and (2) at least 20% of the assessed waterbodies were impaired, as indicated in the most recent 305(b) assessment data.
- Category II - Watersheds Meeting Goals: To qualify as a Category II watershed, the watershed must meet both of the following criteria: (1) at least 15% of the stream miles have been monitored and assessed, and (2) less than 20% of the assessed waterbodies were impaired, as indicated in the most recent 305(b) assessment data.
- Category III - Watersheds containing Pristine / Sensitive Systems: To qualify as a Category III watershed, the watershed must meet each of the following criteria: (1) the watershed contains at least 15% of stream miles as Outstanding Resource Waters, Wild Rivers, or Reference Reach waters.
- Category IV - Watersheds with Insufficient Data: This category is defined as watersheds with less than 15% stream miles assessed.

The South Fork Cumberland River Watershed (USGS Cataloging Unit 05130104) was categorized as Category I - Watersheds in Need of Restoration. Rivers and streams within this watershed were listed as "impaired", "not impaired" or "threatened"; the BSF was listed as "not impaired". Roaring Paunch Creek, which flows into the BSF within the project area, was listed as "impaired". Smaller tributary streams, such as those included in the proposed project, were not included in the Unified Watershed Assessment (*http://water.nr.state.ky.us/dow/cwap.htm*).

4.7.3.2 Project Area Water Quality

In general, streams in the western portion of the BISO are less impacted than streams in the eastern and southern portions of the BISO. However, surface waters in the project area are severely impacted by CMD. Water quality parameter values associated with CMD impacts include (*TDEC 1997*):

- pH – Less than 6.0;
- Alkalinity – Less than acidity;
- Total iron – Greater than 0.5 mg/l;
- Sulfate – Greater than 75.0 mg/l
- Aluminum – Greater than 0.3 mg/l;
- Total hardness – Greater than 150 mg/l; and
- Turbidity – Greater than 200 mg/l.

Water quality parameters of the BSF and tributary streams fluctuate seasonally. Gannett Fleming, Inc. sampled water quality at several locations within the project area from May 1996 to April 1997. A summary of selected parameters are provided in **Table 4-2**. Streams within the project area exhibited low pH, low alkalinity, high iron and aluminum concentrations, and high sulfate concentrations during all or portions of the year. Monthly water quality data for the project area from the aforementioned sampling period is provided in **Appendix D**.

Table 4-2 Range of Water Quality Parameters from May 1996 through April 1997 (monthly sampling events) from Locations within the Project Area

Sample Location	Discharge (cfs)	pH (lab)	Alkalinity (mg/L $CaCO_3$)	Acidity (mg/L Ca CO_3)	Total Iron (Fe, mg/L)	Sulfate (SO_4^{-2}, mg/L)	Aluminum (Al^{+3}, mg/L)
Laurel Branch (mouth)	0.005 – 3.024	3.38 – 5.39	<20 - 20	<10 - 78	0.57 – 7.8	<11 - 160	0.08 – 5.6
Laurel Branch Stream Spoils (seep)	0.03-0.03	2.52 - 2.97	–	300 - 1300	11 - 360	67 - 1600	11 - 89
Devils Creek (mouth)	0.135 – 28.000	3.11 - 6.77	<20 - 24	ND - 140	<0.022 - 16	<11 - 470	<0.024 – 3.2
Blue Heron Spoils (various seeps)	0.035 – 0.400	2.40 – 2.99	-	280-5000	8.1-1,700	580-9,600	8.6 - 480
Three West Hollow (mouth)	0.002 – 7.595	4.73 – 6.43	<20	<10 - <10	<0.022 – 0.31	10 - 58	<0.026 – 0.12
Blair Creek (mouth)	0.033 – 20.395	3.00 – 5.81	<20	<10 - 170	0.64 - 20	<10 - 400	<0.024 – 8.2
Worley Mine # 88	0.036 – 0.248	5.28 – 5.48	<20 - 60	300 - 520	210 - 400	650 - 2200	0.39 – 0.72
Worley Mine # 86	0.005 – 3.024	5.39 – 5.75	<20 - 70	<10 - 420	0.96 - 220	48 – 1,700	<0.024 – 0.12
Slavey Hollow	0.264 – 4.125	5.95 – 7.22	51 - 180	ND - <10	5.3 - 16	270 - 490	<0.024 – 0.26
Nancy Graves (mouth)	0.005 – 1.133	2.85 – 4.11	-	18 - 270	1.1 - 23	44 - 980	0.91 - 17

Source: Gannett Fleming, Inc. 1998
Note: Additional data from which this table was derived is contained in **Appendix D**.

4.7.4 Special Designations

The BSF has the following surface water designations (River Mile 55.0 to River Mile 45.0): WAH, PCR, SCR, and Outstanding State Water Resource (OSRW; 401 KAR 5:026) and Outstanding National Resource Water (ONRW; 401 KAR 5:030). In addition, the BSF is designated as a Kentucky Wild River (KRS 146.241) from the Tennessee/Kentucky border to approximately the Devil's Jump area (River Mile 55.2 to River Mile 45.5).

4.7.5 Floodplains

Floodplains generally are areas of low, level ground present on one or both sides of a stream channel that are subject to either periodic or infrequent inundation by flood waters. Inundation dangers associated with floodplains have prompted federal, state, and local legislation limiting the development in these areas to recreation, agriculture, and preservation activities. Floodplains are regulated by the Federal Emergency Management Agency (FEMA) with standards outlined in 44 CFR Part 60.3.

EO 11988 (24 May 1977) provides guidance on floodplain management. This EO requires each federal agency to amend existing regulations or procedures to ensure that the potential effects of any action the agency may take in a floodplain is evaluated and that the agency's planning programs and budget requests reflect consideration of flood hazards and floodplain management. Guidance for implementation of EO 11988 is provided in the Floodplain Management Guidelines of the U.S. Water Resources Council (40 CFR 6030, 10 February 1978). It is the intent of this EO and EO 11990 (Protection of Wetlands) that federal agencies implement these requirements through existing procedures, such as those established to implement NEPA.

The BSF and its tributaries are deeply incised with limited floodplain development in the project area. The FEMA determines the 100-year floodplains surrounding water bodies. Floodplains have not been officially delineated within the BISO; in the headwater areas, slopes are steep and floodplains are not well formed. Minor floodplains generally occur further downstream, including within some of the proposed project areas. The proposed project areas known to occur at least partially within the floodplain include Blue Heron, Devil's Creek, Nancy Graves, and Slavey Hollow.

4.7.6 Wetlands

The USACE and the USEPA jointly define wetlands as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (*USACE 1987*)."

National Wetlands Inventory (NWI) maps do not identify any wetlands within the project area; however, site-specific wetland delineations have not been completed.

4.7.7 Groundwater Resources and Withdrawal

The major aquifer in this region is the Cumberland Plateau aquifer, which is comprised of Pennsylvanian-aged sandstone, shale, and conglomerate. Due to low primary porosity, groundwater primarily occurs in fractures and faults. As a result, groundwater yields in the Cumberland Plateau vary from 5 to 50 gallons per minute (gpm) to up to 300 gpm. Generally wells do not yield enough water for public supply (*Hoos 1990*).

There is no site-specific groundwater information for the project area; however, groundwater within the BISO is generally moderately mineralized, slightly acidic, and may contain high concentrations of iron, sulfate, chloride, and hydrogen sulfide (*Broshears 1986*). Both confined and perched aquifers are locally common (*Bradley 1982*). Seeps and springs are also common, particularly at the base of ledges and bluff shelters, where the groundwater table intersects the land surface (*Smith 1978*).

Both public and domestic water supply wells occur in the area. One hundred fourteen wells were registered in McCreary County between 1985 and 1996. There are no discharge data available for these wells (*TDEC 1997*).

4.8 Biological Resources

4.8.1 Regulatory Framework

Protection and management of biological resources within the BISO is mandated by a number of laws, regulations, and guidance. The primary statutes, regulations, EOs, and guidance that direct and apply to management of biological resources within the project area include the following:

- ESA of 1973 (16 USC §1531 et seq.) [1]
- Endangered Species Preservation Act of 1966 (16 USC §1531)
- Engle Act of 1958 (10 USC §2671)
- Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (7 USC §136)
- Federal Noxious Weed Act of 1975 (7 USC §2801)
- FWPCA of 1972 as amended by the CWA of 1977 (33 USC §1251 *et seq.*)[2]
- Fish and Wildlife Conservation Act of 1980 (16 USC §2901 et seq.)
- Fish and Wildlife Coordination Act of 1934 (16 USC §661 et seq.)
- Migratory Bird Conservation Act of 1966 (16 USC §715)
- Migratory Bird Treaty Act of 1918 (16 USC §703-711)
- NEPA (42 USC §4321 *et seq.*)[3]
- Sikes Act of 1960 (16 USC §670 et seq.)
- EO 11987, Exotic Organisms, 24 May 1977
- EO 11988, Floodplain Management, 24 May 1977
- EO 11990, Protection of Wetlands, 24 May 1977 [4]

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[1] The protection of Federally-listed species is regulated under ESA. Section 7 of the ESA dictates that federal actions should not jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. Furthermore, Section 7(a) of the ESA requires formal consultation with the USFWS whenever a federal proponent anticipates taking any action that may affect a listed species or critical habitat.

[2] The FWPCA regulates the potential for degradation and actual degradation of the waters of the United States, with the objective of maintaining and restoring their chemical, physical, and biological integrity (USACE 1987 wetland delineation manual). The CWA may be applied specifically to deposition of dredged or fill material into "...waters of the United States, including wetlands." Activities in wetlands for which permits may be required, if there are no feasible avoidance alternatives, include but are not limited to: 1) Placement of fill material; 2) Ditching activities when material is sidecast; 3) Levee and dike construction; 4) Land clearing involving relocation of wetland soil material or removal of hydrophytic vegetation; 5) Land leveling; 6) Most road construction; and 7) Dam construction.

[3] Section 102(2)(H) of NEPA requires that analyses will consider "ecological information" in planning and development of federal actions. This requirement and ARs 200-1 and 200-3 require that analyses conducted pursuant to NEPA investigate potential effects to terrestrial, avian, and aquatic species and habitats.

- EO 11991, Protection and Enhancement of Environmental Quality, 24 May 1977

Biological resources within the BISO are managed according to these and other applicable environmental laws and NPS regulations.

4.8.2 Terrestrial Ecosystems and Communities

Forest communities within the BISO are primarily mixed-oak with mixed mesophytic pockets. Oaks are common on middle and lower slopes; hemlock is often dominant in narrow gorges and along streams; and river birch and sycamore are common on the floodplain. Due to extensive logging in the early-to mid-1900's, most forest stands are 2nd or 3rd growth (*NPS 2000*). Detailed vegetation mapping for the BISO is not available at this time.

4.8.3 Aquatic Habitat

Aquatic habitats within the project area include the BSF and several relatively small tributaries (see **Section 4.7.2**). Portions of the BSF host a diverse biotic community. Approximately 68 species of fish, 215 taxa of macroinvertebrates, and 23 species of mussels occur within the BISO (*NPS 2000*). However, portions of the watershed have been severely impacted by CMD and do not presently support significant biological resources.

Bear Creek is known to be severely impacted by CMD and is a major contributor of polluted waters to the BSF. Above the confluence of Bear Creek, the BSF supports diverse fish and mussel populations, while below the confluence, the BSF supports no mussel and limited fish populations for approximately 12 miles (*NRCS 1997*). The southern portion of the study area is approximately 2 miles downstream from the confluence of Bear Creek and extends downstream approximately 12 miles. The Bear Creek Watershed is currently undergoing restoration efforts to improve aquatic environments within the watershed.

Tributaries of the BSF within the study area (i.e., Worley Branch, Slavey Hollow, Devil Creek, Laurel Branch, and Blair Creek) are primarily first or second order perennial streams characterized by narrow V-shaped gorges created by stream incision (*BISO Water Resources Management Plan 1997*). As discussed in **Section 4.8.3**, these streams are impacted by CMD, and many are void of fish and aquatic invertebrates.

4.8.4 Wildlife Resources

Game species occurring within the BISO include white-tailed deer, raccoon, gray squirrel, ruffed grouse, mourning dove, and turkey; black bear have been reintroduced into the area on an experimental basis (*NPS 2000*). Non-game species are abundant and include a variety of amphibians, reptiles, birds, and mammals; wildlife species recorded in McCreary County are listed in **Appendix E**.

A bat survey of abandoned mine shafts within and adjacent to the BISO was completed in 1983. A total of 114 mine openings was inspected between December 10 and February 17, 1983; many of these mine openings occur within the project area and adjacent or within project sites. Ninety-six mine openings were

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[4] EO 11990 provides guidance on protection of wetlands. This EO requires all federal agencies to issue or amend existing procedures to ensure consideration of wetlands protection in decision-making. It is the intent of this EO and EO 11988 (Floodplain Management) that federal agencies implement these requirements through existing procedures such as those established to implement NEPA. NPS-12 provides guidance for protection of wetlands on NPS properties as a subcomponent of the NEPA process.

surveyed through physical entry and visual inspection and 18 mines openings were surveyed by mist-netting. A total of 351 bats representing the following six species were observed using abandoned mines in the BISO: eastern pipistrelle (*Pipistrellus subflavus*), Rafinesque's big-eared bat (*Plecotus rafinesquii*), big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis lucifugus*), Keen's bat (*Myotis keenii*), and small-footed bat (*Plecotus subflavus*). Although no Federally-listed bats were observed during this survey, a single Indiana bat (*Myotis sodalis*) was observed in a mine shaft near the Blue Heron Spoils site during a preliminary survey in September 1981. This individual was thought to likely be a migrant, using the mine entry as a day roost during migration (*USFWS 1983*).

4.8.5 Special Status Species and Special Habitat Areas

During preparation of this EA, the USFWS, Kentucky Department of Fish and Wildlife Resources, Kentucky State Natural Preserves Commission, Kentucky Department of Natural Resources (KDNR) Division of Conservation, KDNR Division of Forestry, and Kentucky Chapter of the Nature Conservancy were consulted to identify the potential presence of any listed or proposed threatened or endangered species or special habitat areas within the project area. Copies of correspondence with these agencies is presented in **Appendix C.**

Based on correspondence with the above-referenced agencies, the proposed project could potentially affect ten federally-listed species (see **Table 4-3**). Descriptions of these species are provided below.

Table 4-3 Federally-listed Species Potentially Affected by the Proposed Project

Common Name	Scientific Name	Federal Status
Cumberland bean pearlymussel	*Villosa trabalis*	Endangered
Cumberland combshell	*Epioblasma brevidens*	Endangered
Cumberland elktoe	*Alasmidonta altropurpurea*	Endangered
Cumberland rosemary	*Conradina verticillata*	Threatened
Cumberland sandwort	*Minuartia cumberlandensis*	Endangered
Duskytail darter	*Etheostoma (= Catonotus) percnurum*	Endangered
Indiana bat	*Myotis sodalis*	Endangered
Little-wing pearlymussel	*Pegias fabula*	Endangered
Oyster mussel	*Epioblasma capsaeformis*	Endangered
Tan riffleshell	*Epioblasma walkeri*	Endangered

Source: USFWS 2001

The **Cumberland bean pearly mussel** is a small to medium sized freshwater mussel with a relatively thick elongated, oval shells. It was federally listed as Endangered on June 14, 1976. Historic populations occurred in ten river systems in the Cumberland and Tennessee river basins in Alabama, Georgia, Kentucky, Tennessee, and Virginia; however, current populations are only known to occur in a few streams in the upper Cumberland River system in Kentucky and Tennessee. The preferred habitat of this species includes small rivers and streams with fast riffles and gravel or sand and gravel substrate [*Biggins,2001(http://nc-es.fws.gov/mussel/cumberland.html*)].

The **Cumberland combshell** was federally listed as Endangered on January 10, 1997. This species once occurred throughout the Cumberlandian portion of the Tennessee and Cumberland river systems in Alabama, Kentucky, Tennessee, and Virginia (*Gordern 1991*). As of 1990, remnant populations of this species occurred in Buck Creek and the upper BSF main stem in Kentucky (*USFS et al. 1990*).

The **Cumberland elktoe** was federally listed as Endangered on January 10, 1997. This species is endemic to the Cumberland River system in Tennessee and Kentucky and is known to persist in the middle sections of Rock Creek, McCreary County, Kentucky; the upper portions of the Big South Fork Cumberland River basin in McCreary County, Kentucky; and Scott, Fentress, and Morgan Counties, Tennessee; and in Marsh Creek, McCreary County, Kentucky (*Gordon 1991 in* 50 CFR 17).

Cumberland rosemary is a small shrub (approximately 18 inches tall) in the mint family (Lamiaceae). It was federally listed as Endangered on November 29, 1991. Cumberland rosemary is known to occur along the BSF in McCreary County. Appropriate habitat includes boulder bars, gravel bars, and terraces of sand on islands or along stream banks.

Cumberland sandwort is a perennial herb of the Pink family (Caryophyllaceae) with small white flowers and long narrow leaves. It was federally listed as Threatened on June 23, 1988. Only five populations are known, one of which is in McCreary County. This species is restricted to shady, moist rock house floors, overhanging ledges, and solution pockets in sandstone rock faces. The known population in McCreary County is not in the vicinity of the project sites.

The **Duskytail darter** is a small (approximately 2.5 inches long) fish known to occur in only fragmented populations in the middle reaches of the Cumberland River and the upper reaches of the Tennessee River. The duskytail darter was federally listed as Endangered on April 27, 1993 and has only been collected from seven short river reaches including the BSF in Scott County, Tennessee. Although other portions of the BSF have been surveyed no other discoveries of this species have been made. Therefore, this species is not expected to occur in the project area.

The **Indiana bat** is a medium-sized myotis with grayish-chestnut fur. It was federally listed as endangered on March 11, 1967 and a recovery plan was developed in 1976 and revised in 1983. This recovery plan is currently being revised again. The Indiana bat occurs in the midwest and eastern U.S. The bat hibernates in limestone caves averaging approximately 37 °F to 43 °F in midwinter and a relative humidity averaging 87 percent. The Indiana bat may also winter in mines that satisfy their highly specific needs. During the summer, Indiana bats forage for insects in riparian and upland forests. Maternity colonies roost under the bark of trees in both riparian and upland areas, specifically in trees with exfoliating bark, dead limbs or cavities. This species has experienced severe declines in Kentucky (approximately 180,000 bats between 1960 and 1997; USFWS 1999). As discussed in **Section 4.9.4**, the Indiana bat is known to occur as a migrant in the project area.

The **Little wing pearlymussel** was listed as Endangered on November 14, 1988. An extensive survey for this species of over 55 potential or historic habitat areas was completed in 1986. Only 17 live mussels were found during this survey. This included findings from three sites in southeastern Kentucky, two in southwestern Virginia, and one in central Tennessee. One of these sites was within the BSF in McCreary County, Kentucky. Preferred habitat of this species includes transition zones between pools and riffles in small to medium, cool, high to moderate gradient streams with low turbidity (*USFWS 1990*).

The **Oyster mussel** was federally listed as Endangered on January 10, 1997. Historic populations occurred throughout much of the Cumberlandian region of the Cumberland and Tennessee River drainages in Alabama, Kentucky, Tennessee, and Virginia. Within the Cumberland River system, this species is only known to occur in Buck Creek, Pulaski County, Kentucky; and in a few miles of the BSF in McCreary County, Kentucky and Scott County, Tennessee (*Bakaletz 1991*).

The **Tan riffleshell** was listed as Endangered on August 23, 1977. This species historically occurred in Alabama, Kentucky, North Carolina, Tennessee, and Virginia. However, the only known reproducing population occurs in Indian Creek, Tazew County, Virginia (*Rogers 1999*).

Freshwater mussel species discussed above are not known to occur in the BSF downstream of Bear Creek, which is where the project area is located (*Bakaletz, personal communication, 2001*). Therefore, federally listed freshwater mussels are not expected to occur within the project area.

4.9 Cultural Resources

4.9.1 Regulatory Framework

4.9.1.1 Definition

Cultural resources are prehistoric and historic sites, structures, districts, or any other physical evidence of human activity considered important to a culture, subculture, or a community for scientific, traditional, or religious reasons (36 CFR part 64). Based on statutory requirements, the term cultural resources is defined to include:

1. Historic properties, as defined in the NHPA of 1966, as amended;
2. Cultural items, as defined in the Native American Graves and Repatriation Act (NAGPRA);
3. Archaeological resources, as defined in the Archeological Resources Protection Act (ARPA);
4. Historic and paleontological resources, as defined by the Antiquities Act of 1906, as amended;
5. Sites that are scientifically significant, as defined by the Archeological and Historic Data Preservation Act (AHPA);
6. Sacred sites, as defined in EO 13007, to which access and use is permitted under the American Indian Religious Freedom Act (AIRFA); and
7. Collections, as defined in 36 CFR Part 79, Curation of Federally-Owned and Administered Collections.

The NPS defines cultural resources as "an aspect of a cultural system that is valued by or significantly representative of a culture or that contains significant information about a culture. A cultural resource may be a tangible entity or a cultural practice. Tangible cultural resources are categorized as districts, sites, buildings, structures and objects for the National Register of Historic Places (NRHP), and as archeological resources, cultural landscapes, structures, museum objects and ethnographic resources for NPS management purposes." (*NPS-28, Appendix A*).

4.9.1.2 Overview of Applicable Regulations

Applicable laws, regulations, and EOs related to the protection of cultural resources are listed below.

- ACHP, Protection of Historic and Cultural Properties (36 CFR §800)
- AIRFA of 1978 (PL 95-341; 42 USC §1996)
- Antiquities Act of 1906 (PL 59-209)
- AHPA of 1974 (PL 93-291; 16 USC §469-469c)
- ARPA of 1979 (PL 96-95; 16 USC §470aa-47011)
- NEPA of 1969 (PL 91-190; 42 USC §4321 *et seq.*)
- NHPA of 1966 (PL 95-515; Public Law 102-575; 16 USC §470)
- NAGPRA of 1990 (PL 101-601; 25 USC §3001-3013; *as implemented by* 43 CFR §10)

- Historic Sites Act of 1935 (16 USC § 461-467)
- EO 11593, Protection and Enhancement of the Cultural Environment (1971)
- EO 13007, Indian Sacred Sites, 24 May 1996.

NEPA requires that federal entities ensure that cultural resources, as defined by the above-stated regulations, are fully considered when preparing NEPA analyses.

The NHPA establishes the federal government's policy to provide leadership in the preservation and management of historic properties. Under Section 106 of the NHPA, as well as 36 CFR §800, federal agencies are required to identify and protect historic properties included in, or eligible for listing on, the NRHP. *Historic properties* may be archaeological sites (both prehistoric and historic), buildings, structures, objects, or districts. The federal proponent is responsible for seeking the comments of the Advisory Council on Historic Preservation (ACHP) under 36 CFR §800 on projects that affect historic properties. In the Commonwealth of Kentucky, all federal projects are reviewed by the Kentucky Heritage Council within the SHPO. Acting as the State Historic Preservation Officer, the Executive Director of the Council directs the federal preservation program in Kentucky including the NRHP, Historic Preservation Tax Credits, NHPA Section 106 Environmental Review, Certified Local Governments, and Preservation Grants-in-Aid.

4.9.1.3 Significance Criteria

In order for a cultural resource to be considered significant, it must meet one or more of the criteria for inclusion on the NRHP, as described below:

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and: 1) that are associated with events that have made a significant contribution to the broad patterns of our history; or 2) that are associated with the lives or persons significant in our past; or 3) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or 4) that have yielded, or may be likely to yield, information important in prehistory or history (36 CFR §60:4).

Only significant cultural resources warrant consideration with regard to adverse impacts resulting from implementation of a proposed action. Generally, cultural resources must be more than 50 years old to receive protection under federal laws.

4.9.2 Architectural and Archaeological Resources within the BISO

Numerous surveys pertaining to cultural resources have been completed within the BISO and indicate that the area has been occupied for over 12,000 years. Although shallow caves and rock shelters within the BISO were most likely used by Native Americans, no evidence of permanent Native American settlements has been discovered. It is assumed that most sites have been looted and that artifacts (i.e. pots, bowls) have been taken illegally. Based on sampling, it is estimated that over 10,000 archeological (both historic and prehistoric) sites exist within the boundaries of the BISO. However no pre-historic sites are known to occur in close proximity to the project sites (*NPS 2000*).

Conversely, *historic* sites do occur in the project area and are predominantly remnants of past mining operations, mining towns, homesteads, railroad spurs, and mine portals. Hutchinson *et al.* (*1982*) completed an inventory and evaluation of architectural and engineering resources within the BISO and named Worley as one of seven areas identified as highly sensitive in terms of historic archaeological resources. In addition, based on topographic maps from the 1930's, Hutchinson *et al.* (*1982*) identified over 140 potential archeological sites in the Kentucky portion of the BISO. A rock located in the vicinity of the proposed Laurel Branch project site that has inscriptions from historic mining operations is considered by BISO personnel to be a significant artifact.

As detailed in the intergovernmental correspondence contained in **Appendix C**, the Kentucky SHPO found that the proposed project has the potential to impact properties eligible for listing in the NRHP. Their review of the projects proposed for analysis within this EA concluded that the Worley Mine area contains extant features from the mine and community that was associated with the mine, including the old railroad, foundations of buildings, a tipple, and stairways. In addition, the SHPO indicated that there is a potential for archeological sites along the BSF floodplain. At this time, no legally adequate Phase I archaeological reconnaissance surveys are known to have been competed for the proposed project areas.

4.10 Socioeconomics

The project area lies within McCreary County, Kentucky. The following subsections identify and describe the basic attributes and resources associated with the human environment in McCreary County. This data is presented in order to provide an understanding of the socioeconomic forces that have shaped, and continue to shape, the area. Socioeconomic areas of discussion include demographics, local economy; local housing, schools, medical facilities, service facilities, and recreational facilities; and associated issues of health and safety to the surrounding communities.

4.10.1 Land Area and Demographics

McCreary County, which covers approximately 428 square miles, is located in southeastern Kentucky on the northern border of the State of Tennessee. It is bordered by Wayne County to the west, Pulaski County to the north, Whitney County to the east and Scott and Campbell, Counties, Tennessee to the south. The county seat is located in Whitley City, but there are no incorporated towns in McCreary County. Fifty-three percent of land area within the county is occupied by the Daniel Boone National Forest and 12 percent of the land area belongs to the BISO. The BISO, which occupies portions of five counties in Kentucky and Tennessee, is visited annually by approximately 800,000 to 900,000 people. Summer and fall are the most popular times to visit, spring is the next most popular time, while winter brings the fewest visitors (*NPS 2000*).

According to the U.S. Census Bureau, the population of McCreary County was 15,603 in 1990 and 17,080 in 2000, an increase of 9.5%. Approximately 98% of the population of McCreary County is white; the remaining population is classified as African-American (0.6%), American Indian or Alaska native (0.4%), persons of two or more races (0.7%) and other (0.2%). Persons of Hispanic or Latino origin (approximately 0.6 %) may be of any race and are included in applicable race categories (*U.S. Census Bureau 2000*).

4.10.2 Local Economy

There are no metropolitan areas in McCreary County. In 1994 civilian labor force was 6,649 and between 1975 and 1994 unemployment ranged from 7.4% to 18.8% (*DOJ-FBP 1999*). In 1997 approximately 35.3% of the population was estimated to be below poverty level and approximately 46.6% of children were estimated to be below poverty level. Median household income in 1997 was estimated to be

$16,433. Total retail sales in 1997 were approximately $52,448,000 and per capita sales were $3,161 [*U.S. Census Bureau 2000 (http://quickfacts.census.gov/cgi-bin/county?cnty=21147)*].

4.10.3 Housing

According to data from the 1990 Census (CY 2000 data on this subject is not yet available), 6,039 housing units were present in McCreary County. Of these, approximately 91% were occupied and approximately 75% of the occupied units were owner-occupied. The remaining 25% of occupied units were renter-occupied. The majority of housing units in the county are classified as single-family, detached units (approximately 68%) or mobile homes (approximately 24%). The median value of owner-occupied units in 1990 was $26,300 and median monthly gross rent was $217 (*U.S. Census Bureau 1990*).

4.10.4 Schools

The McCreary County public school system consists of five elementary schools (kindergarten through fifth grades), two middle schools (sixth through eighth grades), and one high school (ninth through twelfth grades). In addition, there is one pre-school and one alternative school available to students in the county [*McCreary County Schools 2001 (http://www.mccreary.k12.ky.us/index.htm)*]. The student to teacher ratio is approximately 15:1. The school system graduated 176 students in 1998 and 76 of these students (43%) went on to attend post-secondary educational institutions (*DOJ-FBP 1999*).

4.10.5 Shops and Services

No shops or services exist within the BISO, with the exception of a small bookstore maintained at each of the two visitor centers within the BISO. Local shopping and services for area residents and BISO permanent and temporary employees is provided by retailers in the local communities.

4.10.6 Recreational Facilities

The BISO provides river use (i.e., swimming, fishing, rafting, and kayaking), trail use (i.e., hiking, horseback riding, mountain biking, all-terrain vehicle use), hunting, and various other activities such as rock climbing, nature study, and camping. These recreational opportunities are allowed throughout the BISO, including the project area.

River use within the BISO includes swimming, rafting, motorized and non-motorized boating, and fishing. All of these activities are allowed along the BSF in close proximity to the project sites. Swimming, fishing, and motorized boating are popular among both local and regional visitors, while rafting and kayaking are generally more popular among regional visitors. Fishing is allowed in accordance with state regulations.

Trail use, sight-seeing, and camping are popular within the BISO. Trail use makes up a large portion of total visitor use within the BISO. Trails in the project area include both single-use trails and multi-use trails. Trail use within the project area includes hiking, horse-back riding, and mountain biking. Both improved and back country camping are available within the BISO. All-terrain vehicle use is also allowed on certain unmaintained roads in the area.

Hunting is very popular within the BISO and occurs in all areas except designated safety zones around developed sites. Hunting for deer and water fowl occurs along the BSF and is managed consistent with state regulations and NPS safety zones. Much of the BSF project area is within a safety zone. Worley Mine 88 and Slavey Hollow are the only project sites that lie outside of an established safety zone.

The Big South Fork Scenic Railway is a National Park concessionaire. The Scenic Railway operates out of Stearns, Kentucky and offers trips along the historic tracks of the K & T Railway. The Big South Fork Scenic Railway operates on the existing railway from Stearns through the BISO to the Blue Heron historic mining community and north along the Big South Fork to Worley. Trips on the Big South Fork Scenic Railway are available form April through October. The Worley Mines 86 and 88 and access routes to these sites are located adjacent to the K & T tracks on which the Scenic Railway operates.

4.10.7 Public and Occupational Health and Safety

4.10.7.1 Law Enforcement

Law enforcement within McCreary County is shared between the Kentucky State Police and the McCreary County Sheriff's Department. Emergency 911 service is administered through the McCreary County Sheriff's Department. The Sheriff's Department has jurisdiction within the BISO, but law enforcement is primarily conducted by NPS Park Rangers. The BISO has eight Park Rangers, three of which are responsible for the Kentucky portion of the park (*Bakaletz, personal communication*).

4.10.7.2 Fire Protection

The NPS is responsible for control of wildfires within the BISO, while local fire department(s) respond to structural fires.

4.10.7.3 Medical Facilities

There are no hospitals in McCreary County. The closest hospital to the project area is in Oneida, Tennessee, which is located approximately 15 miles to the south.

4.10.8 Protection of Children

Because children may suffer disproportionately from environmental health risks and safety risks, EO 13045, Protection of Children from Environmental Health Risks and Safety Risks, was introduced on April 21, 1997. EO 13045 was intended to prioritize the identification and assessment of environmental health risks and safety risks that may affect children and to ensure that federal agencies policies, programs, activities, and standards address environmental risks and safety risks to children.

With the exception of BISO visitors, no children are present in the project area; no day-care facilities, schools, or other facilities with typically higher numbers of children occur in close proximity to the project area. At this time, there are no statistics available estimating the numbers of children that visit the BISO, including the project area.

4.11 Environmental Justice

4.11.1 Regulatory Framework

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, dated 11 February 1994, was issued to focus attention of federal agencies on human health and environmental conditions in minority and low-income communities and to ensure that potential disproportionately high and adverse human health or environmental effects on these communities are identified and addressed. In order to provide a thorough environmental justice evaluation, this section describes the distribution of race and poverty status in areas surrounding the BISO and potentially affected by implementation of proposed actions. Overall, most residences in the vicinity of the BISO are rural in nature, and are not known to be exceptionally minority-based.

4.11.2 Geographic Distribution of Minority Populations

According to the U.S. Census Bureau, and as previously discussed in **Section 4.10.1**, approximately 98% of the population of McCreary County is white; the remaining population is classified as African-American (0.6%), American Indian or Alaska native (0.4%), persons of two or more races (0.7%) and other (0.2%). Persons of Hispanic or Latino origin (approximately 0.6 %) may be of any race and are included in applicable race categories (*U.S. Census Bureau 2000*).

For the most part, minority populations in the areas surrounding the BISO are low. Relative African-American populations are considerably lower for these areas than for the rest of the Commonwealth of Kentucky, while relative proportions of persons of Hispanic or Latino origin (who may be of any race) are slightly lower than the State average. Relative proportions for the other races detailed in the 1990 U.S. Census, including 'American and Alaska native', 'Asian', Native Hawaiian or Pacific Islander', and other races were relatively similar to overall State figures (*U.S. Census Bureau, 2000*).

4.11.3 Geographic Distribution of Low-income Populations

Based on a 1997 model-based estimate provided by the U. S. Census Bureau, approximately 35.3% of the population for McCreary County was determined to exist at or below the poverty level, while the Commonwealth of Kentucky overall registered approximately 16.0%. Median household income for McCreary County ($16,433) was slightly more than half the overall state median income of $31,730.

Generally, this area demonstrated considerably lower average per capita income and higher population percentages living below the poverty level than for the overall Commonwealth of Kentucky, with the county exhibiting a population demographic of more than one-third at or below the national poverty level. As such, it has been determined that McCreary County is likely subject to Environmental Justice concerns based on its' population's exceptionally low-income status.

4.11.4 Consumption Patterns

Based on socioeconomic data consulted and referenced in the above sections, coupled with interviews of BISO personnel, no identifiable populations or local groups in the vicinity of the BISO currently *principally* rely on fish or wildlife for subsistence. Of the BISO personnel interviewed to gather data for preparation of this EA, no one identified any local population segments that meet these criteria.

4.12 Infrastructure

4.12.1 Potable Water Supply and Wastewater Treatment

Water supply for McCreary County, including areas within the BISO, is provided by the McCreary County Water District (District). The District owns and operates its water treatment plant near the community of Whitley City, as sourced by the Laurel Creek Reservoir. The District serves approximately 5,000 residential, commercial, and industrial customers.

The District also owns the only public wastewater treatment system in the county. This treatment plant provides service to areas in and around Whitley City. Wastewater treatment within the McCreary County portion of the BISO is accomplished by use of septic tanks.

No water supply or wastewater treatment (or storage) facilities are within or adjacent to any of the proposed project sites.

4.12.2 Energy Sources

The South Kentucky Rural Electric Cooperative Corporation (SKRECC) provides electricity to nearly 55,000 members in parts of thirteen counties which include Pulaski, Russell, Wayne, Clinton, McCreary, Casey, Lincoln, Adair, Rockcastle, Cumberland, and Laurel counties in Kentucky, and Pickett and Scott counties in Tennessee. A SKRECC powerline right-of-way crosses the Nancy Graves project site, and in general services the general project area. No natural gas facilities or infrastructure are located in close proximity to the project sites; Liquid Propane (LP) gas is used for heating at most area homes, and is provided by licensed local companies.

4.12.3 Transportation Systems

4.12.3.1 Local Roadways, Use, and Access to Project Sites

The road system within McCreary County consists of one U.S. Highway, and state and county routes. U.S. 27 runs north-south through roughly the geographical center of the county, east of the BISO. State Route (SR) 92 is the major east-west highway in the county. The project area is located approximately five miles west of the junction of U.S. 27 and SR 92. As discussed previously, the project area includes eight project sites, totaling approximately 22 acres. Five of project sites are on the east side of the BSF, while four of the sites are on the west side of the BSF. SR 92 crosses the BSF approximately two miles north of the Worley Mine 86 Site and allows access to the west side of the river. Improved roads within the BISO allow access to the general project area, but individual project sites must be accessed by trails and/or unimproved, unmaintained roads originally built for mining and/or timbering operations. Improved roads are utilized by local residents, BISO visitors, and NPS employees. **Figure 1-3** shows roads and trails in the vicinity of the project area and potential access routes to the project sites.

4.12.3.2 Rail Access and Service

With the exception of the Big South Fork Scenic Railway, there is no train service in the immediate vicinity of the project area. Rail service is available in and near Oneida, Tennessee.

4.12.3.3 Airports

McCreary County operates a general aviation airport licensed to the Commonwealth of Kentucky. This airport consists of a 3000-foot, unlighted paved runway, a stub taxiway, a terminal building, an aircraft hangar, and an apron area. The closest commercial airport is located in Knoxville, Tennessee, approximately 50 miles to the south.

4.13 Hazardous and Toxic Materials/Wastes

Hazardous wastes are defined as any solid, liquid, contained gaseous or semi-solid waste, or any combination of wastes, which pose either a substantial present or potential hazard to human health or the environment, as determined by ignitable, corrosive, reactive, or toxic characteristics.

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Superfund Amendments and Reauthorization Act (SARA), and the Resource Conservation and Recovery Act (RCRA) are the primary regulations that govern hazardous material and waste use, handling, and remediation on Federal properties. No hazardous wastes are generated, stored, handled, transported, treated, or disposed within the project area, and with the exception of historical mining activities, no activities have been conducted at the project sites that could potentially result in contamination by a hazardous material, substance, or waste.

Partially pyrolized spoil piles from historic mining operations occur throughout the project area and contribute CMD to local streams and drainages. CMD generally is characterized by relatively low pH, high acidity, and high heavy metal concentrations. Although partially pyrolized spoil piles and CMD exhibit characteristics that are considered hazardous to human health and the environment, they are not, at this time, considered to be hazardous waste.

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5.0 ENVIRONMENTAL CONSEQUENCES

5.1 General Overview

This section identifies potential direct and indirect effects of the identified alternatives on each of the issue areas presented in **Section 4.0**, and compares and contrasts potential effects of alternatives. The potential environmental, cultural, and socioeconomic effects of implementing each of the alternatives are identified, as well as mitigation measures associated with each that, when implemented, would reduce the level of identified impacts. There would be no environmental consequences associated with geographic setting or climate; therefore, these issues are not addressed further in this section.

5.1.1 Direct Versus Indirect Impacts

The terms *impact* and *effect* are synonymous as used in this EA. Impacts may be determined to be beneficial or adverse, and may apply to the full range of natural, aesthetic, historic, cultural, and economic resources of the BISO. Definitions and examples of direct and indirect impacts as used in this document are as follows:

- **Direct Impact:** A *direct impact* is caused by the proposed action, and occurs at the same time and place as the proposed action.

- **Indirect Impact:** An *indirect impact* is caused by the proposed action and occurs later in time or farther removed in distance, but is still reasonably foreseeable. Indirect impacts may include induced changes in the pattern of land use, population density or growth rate, and related effects on air, water, and other natural and social systems.

- **Application of Direct Versus Indirect Impacts:** For direct impacts to occur, a resource must be present in a particular study area. For example, if vegetation resources were disturbed in a particular area, there would be a *direct* impact to wildlife as a result of displacement from available habitat. This displacement from habitat would *indirectly* affect habitat in adjacent areas by increasing the wildlife population in those areas.

5.1.2 Short-term Versus Long-term Impacts

In addition to indicating whether impacts are direct or indirect, the impact matrix summaries included in this section also distinguish between short- and long-term impacts. In this context, short- and long-term do not refer to any rigid time period and are determined on a case-by-case basis in terms of the environmentally significant consequences of the proposed action.

5.1.3 Cumulative Impacts

As described in **Section 2.0**, the NPS proposes to perform remediation activities at several contaminated mine drainage sites at the BISO to help improve the water quality and aquatic habitat in the BSF and its tributaries. **Sections 5.3 through 5.13** identify potential direct and indirect, short-term and long-term impacts associated with each of the three specific project alternatives. **Section 5.14** evaluates the cumulative impact of the proposed actions, which takes into account known existing, potential, or anticipated impacts associated with other local or regional activities currently being undertaken or anticipated by other landowners and decision-making authorities.

5.1.4 Significance Criteria

The term "significance" as used in NEPA requires consideration of both the context and *intensity* of the impact or effect under consideration. Significance can vary in relation to the context of the proposed action. For the proposed actions at the BISO, context may include consideration of effects on a regional, and/or local basis. Both short- and long-term effects may be relevant. Impacts are also evaluated in terms of their intensity or severity. Factors contributing to the intensity of an impact include:

- The degree to which the action affects public health or safety;
- The proximity of the action to resources which are legally protected by various statutes such as wetlands; resources listed in, or eligible for, the National Register of Historic Places; regulatory floodplains; and, federally listed threatened or endangered species;
- The degree to which the effects of the action on the quality of the human environment are likely to be highly uncertain or controversial;
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts; and
- Whether the action threatens to violate federal, state, or local law imposed for the protection of the environment.

5.1.5 Mitigation

Mitigation measures are discussed for each alternative, as appropriate. Where significant adverse impacts are identified, this document describes measures that will or could be used to mitigate these effects to acceptable levels. Mitigation measures generally include:

- Avoiding the impact altogether by stopping or modifying the proposed action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action, such as implementation of appropriate and accepted Best Management Practices (BMPs); and,
- Compensating for the impact by replacing or providing substitute resources or environments.

In this EA, mitigation commitments are limited to anticipated adverse impacts associated with the Preferred Action Alternative, Modified Action Alternative, and the No Action Alternative. The NPS' mitigation commitments associated with these proposed actions are identified by the use of the terms "will" or "shall" in **Sections 5.3 through 5.13**. In addition, a summary of mitigation commitments is included in the **Executive Summary** of this document. Mitigation measures taken to reduce or avoid the selected action's adverse environmental effects will also be included in the Finding of No Significant Impact (FONSI) prepared after the completion of the public comment period for the draft EA, as appropriate and applicable. Only those mitigation measures that are practicable (i.e., can be accomplished as part of the primary action) have been identified.

5.2 Description of Effects

5.2.1 Effects Common to All Alternatives

Most of the proposed projects involve some type of construction. As such, it can therefore be ascertained that at least some type of land clearing or earth-moving would be required. In such cases (nearly all cases), potential adverse effects may be possible as a result of:

- Soil Erosion
- Sedimentation
- Airborne dust from heavy machinery operation
- Spills of hazardous materials

Although common and even seemingly benign, the above-mentioned effects can present major adverse effects to resources, especially if a number of areas are involved, collectively contributing to a larger effect. However, just as multiple small sources can manifest single (or even multiple) larger effects, appropriate control of small-scale effects can diminish or prevent large-scale effects from being manifested (sometimes at all).

5.2.2 Mitigation Measures Common to All Alternatives

A number of mitigation measures have been determined to be common to Alternatives 1 and 2. These *standard mitigation measures* are listed below:

1. ***Preparation of a soil erosion and sedimentation (E&S) control plan.*** This mitigation measure involves preparation, as well as approval and implementation of an E&S control plan, as appropriate, including use of general soil erosion control and soil stabilization BMPs.

   Nearly every proposed project, both large and small, considered in this EA involves periods of construction. During construction activities, soil disturbance in the project construction zones would result in exposure of unvegetated soil, as well as the direct potential to erode soils. While this impact may not be significant on a case-by-case basis for the smaller actions, collectively the disturbance of 22 acres throughout the BISO would be a potentially significant disturbance and potential erosion impact.

   This measure requires that specific activities to control and minimize potential construction impacts be identified in an appropriate, project-specific E&S Control Plan, approved by the KDEP, Division of Water, in conjunction with local county soil and water conservation districts and the NRCS, and implemented by the NPS prior to initiation of and during construction, in accordance with applicable Kentucky regulations. At a minimum, specific activities that shall be addressed within the overall project-specific Plan include:

   - Improving certain existing and newly constructed trails using stone and geotextile materials to prevent and reduce trail degradation and associated soil erosion.
   - Installing and monitoring erosion-prevention measures (BMPs) such as silt fences and water breaks, sedimentation basins, filter fences, sediment berms, interceptor ditches, straw bales, rip-rap, and/or other sediment control structures *prior to construction*, and modified as necessary during construction to prevent erosion; re-spreading of stockpiled topsoil; and seeding/revegetation of areas temporarily cleared of vegetation.
   - Retaining forest vegetation and riparian vegetation to the maximum extent possible.

- Planting and maintaining soil-stabilizing vegetation on and adjacent to disturbed areas.
- Using native grasses to revegetate disturbed soils.
- Revegetating during the optimum seeding periods (February 1 – May 15 or August 1 – October 31 for cool season grasses; and April 15 – June 1 for warm season grasses).
- A long-term monitoring component to ensure that the various proposed actions are monitored for resultant erosion and periodically maintained/repaired to ensure minimization of operational erosion and sedimentation.

2. ***Acquisition of land disturbance permit(s) associated with the National Pollutant Discharge Elimination System (NPDES).*** In order to minimize the potential impacts to land and aquatic systems at the BISO, the NPS shall obtain all required permits before the commencement of any proposed construction activities. Permits related to ground disturbance that may be required, depending upon the specific project, include:

   - A NPDES Permit for Storm Water Discharges Associated with or from Construction Activities (40 CFR 122.26).

   The NPDES program within the State of Ohio is administered by the KDEP, Division of Water. Permit acquisition shall be coordinated with the KDEP, Division of Water at the earliest time possible prior to construction activities, in order to ensure that activities are consistent with Federal and State regulatory standards. Permit standards shall be adhered to during all on-site construction activities.

3. ***Airborne dust control.*** Construction of each proposed action would involve earth movement and re-grading, among other typical construction activities. Emissions of airborne particulate matter (dust) are usually associated with wind-oriented soil erosion, resultant from disturbance of on-site soils. The NPS will ensure that dust control associated with construction of the proposed facilities at the BISO is conducted in accordance with applicable State regulations. In order to minimize the potential for adverse air quality impacts, the NPS shall implement procedures for ensuring the consistent usage of the following typical dust control BMPs, as applicable:

   - Utilize appropriate dust suppression methods during on-site construction activities. Available methods include application of water, soil stabilizers, or vegetation; use of enclosures, covers, silt fences, or wheel washers; and suspension of earth-movement activities during high wind conditions.
   - Maintain a speed of less than 15 mph with construction equipment on unpaved surfaces.
   - Use electricity from established electrical power sources instead of generators whenever possible.
   - Repair and service construction equipment according to the regular maintenance schedule recommended for each individual equipment type.
   - Use "transport controls", such as limiting construction and training activities during extended periods of dry weather.
   - Incorporate energy-efficient supplies whenever feasible.

   The NPS shall visually monitor all construction and operational activities within the project area regularly, and particularly during extended periods of dry weather, so as to minimize the potential for air quality impacts.

4. ***Spill prevention.*** Construction activities typically generate wastes and disturb soil in localized areas during construction and establishment of training and support facilities. These construction activities may result in spills or leaks to the environment. The potential for environmental contamination during construction may be considered a significant impact. However, through implementation of

appropriate mitigation measures, such impacts will be mitigated to less-than-significant levels. The NPS shall, during any on-site construction activities within a specific project area, implement the following measures to minimize the potential for spills or other harm to the environment:

- Implement applicable spill response and contingency plans following any release to the environment. This includes reporting spills to the appropriate local, state, and federal government agencies, as required based on the type and volume of the release.
- Implement storm water BMPs, as required (see #2, above).
- Refuel construction equipment on relatively flat, paved surfaces when possible. Transfers shall be conducted during periods when atmospheric precipitation is not occurring. Secondary containment shall surround the transfer area to prevent an accidental release from leaving the immediate area. Transfers shall not be conducted near navigable bodies of water, including storm sewer inlets, unless absolutely necessary.
- Maintain construction equipment to prevent drips or leaks from hoses or reservoirs which contain hazardous materials or substances.
- Maintain appropriate on-site solid waste disposal receptacles to prevent the release of pollutants into the environment from demolition and construction activities.
- Update or prepare required spill prevention containment and countermeasures (SPCC) plans (40 CFR Part 112), contingency plans, and/or other pollution prevention plans, as required, for the BISO installation overall and for all proposed future facilities, as applicable.

These BMPs have been determined as necessary for all phases of construction, and in certain cases, necessary to maintain or protect sensitive resources permanently. Summary descriptions of projects assessed in this EA, along with an analysis of projects to which each of these standard mitigation measures apply, are shown in **Table 5-1**.

Table 5-1 Summary Descriptions of Project Impacts Considered in this EA (Alternative 1)

Project Site	Project Description (Preferred Action Alternative)	Anticipated Acreage Impact	Standard Mitigation Measures
Laurel Branch Stream Spoils	Install culverts to segregate stream from mine spoils, and line upstream area of permeable alluvial deposits or construct cut-off trench at upstream end of spoil pile.	1	**1,2,3,4**
Laurel Branch Confluence	Regrade spoil area and construct an interceptor channel at the edge of spoil to convey surface runoff away from spoil.	2	**1,2,3,4**
Devils Creek	Intercept mine waters and construct an ALD and a two-celled aerobic treatment system.	2	**1,2,3,4**
Blue Heron Spoils	Regrade selected areas, divert surface waters from mine spoils via lined ditches, and remove sediment pond.	10	**1,2,3,4**
Blair Creek	Construct treatment system on floodplain, drill into mine at stream level, and pipe CMD to constructed wetland on floodplain. Grout portions of creek upstream of the crop line.	1	**1,2,3,4**
Worley Mine #88	Construct anaerobic up-flow wetland and pipe CMD from mine adit to wetland. Construct small sediment settling ponds adjacent to rail bed.	<1	**1,2,3,4**

Project Site	Project Description (Preferred Action Alternative)	Anticipated Acreage Impact	Standard Mitigation Measures
Worley Mine #86	Install ALD and construct wetland treatment system in Worley Branch drainage basin.	1	**1,2,3,4**
Slavey Hollow	Construct wetland treatment system on floodplain and pipe CMD to wetland from mine portal.	2	**1,2,3,4**
Nancy Graves	Redirect stream and construct lined stream channel to direct water away from spoil piles; and construct wetland treatment system on BSF floodplain and pipe CMD from powerline seeps to wetland.	2	**1,2,3,4**

5.3 Land Use

5.3.1 Effects of Alternative 1 (Preferred Action Alternative)

Land use in the project area would sustain *direct and indirect short- and long-term* impacts as a result of implementing Alternative 1. Currently, the project sites and portions of access routes (i.e., trails) are available for outdoor recreational activities such as hiking and horseback riding. Outdoor activities in close proximity to the project sites and along access routes would be limited during construction activities. This impact is considered *short-term and adverse*, but similar impacts would occur periodically throughout the life of the treatment systems as a result of maintenance activities.

Trails and roads within the project area would sustain *direct and indirect short-term* impacts as a result of implementing Alternative 1. During the construction of the proposed remedial facilities, visitors to the BISO could be excluded from trails being used for access to the project sites. This could increase the usage of other trails. However, following construction of the proposed project, regular use of the trails and roads would continue. No long-term adverse impact to land use within the project area would be expected as a result of implementing Alternative 1.

5.3.2 Effects of Alternative 2 (Modified Action Alternative)

Project site locations and access routes for Alternative 2 would be the same as Alternative 1; areal extents of disturbance would likely be identical. Therefore, effects on land use as a result of Alternative 2 would be similar in nature to those identified for Alternative 1.

5.3.3 Effects of Alternative 3 (No Action Alternative)

Under the No Action Alternative, none of the proposed actions would be implemented and no changes in land use would occur. One *major, long-term, adverse* land use impact would continue to occur if the proposed remediation activities are not conducted, in that the specific BSF tributary streams, and the BSF river overall, would continue to be adversely impacted by CMD, subsequently continuing to render these tributary streams unsuitable for aquatic life.

5.3.4 Mitigation Measures

Based on the results of the land use evaluation discussed above, specific mitigation measures are required for implementation of certain proposed actions under both the Preferred Action Alternative and the Modified Action Alternative. In addition to the common mitigation measures identified in **Section 5.2.2** and **Table 5-1**, specific mitigation measures are required to address identified adverse land use impacts, and are summarized as follows:

- The NPS will schedule construction and maintenance of the proposed projects to minimize impacts to current recreational land use, including use of trails and associated staging areas; if possible, the NPS will keep access to horseback riding trails open during construction activities. If this is determined to not be possible, or if suitable alternative temporal periods for construction are not available, the NPS will plainly indicate, to potential users of such trails and other areas, that the project areas proposed for construction are to be avoided as necessary.
- Construction and maintenance of the proposed projects in the vicinity of the Big South Fork Scenic Railway (Worley Mine #88 and #86 areas) will be scheduled during periods when the railway is not in operation *and/or* the NPS will coordinate with the owners of the Big South Fork Scenic Railway to secure permission to use areas within the Scenic Railway right-of-way.

Implementation of these measures, in addition to those identified in ***Table 5-1****, would reduce the identified land use impacts associated with the Preferred Action Alternative and Modified Action Alternative to less-than-significant levels.*

No mitigation measures are proposed for implementation of the No Action Alternative. Failure to perform remediation activities would constitute an *unmitigable land use impact*, and would compromise the long-term integrity of the BISO as a recreational area and preserve.

5.4 Air Quality

5.4.1 Effects of Alternative 1 (Preferred Action Alternative)

Short-term direct impacts to air quality would result from activities associated with Alternative 1. Fugitive dust from on-site construction activities (earth-moving activities and grading) and mobile source emissions from construction vehicles, equipment, and the motor vehicles of construction workers would have short-term impacts on air quality in the project area. Mobile source emissions during construction would be minor and short-term in nature. Similar minor short-term air quality impacts would occur periodically throughout the life of the project during maintenance periods.

5.4.2 Effects of Alternative 2 (Modified Action Alternative)

Effects of Alternative 2 would be similar in nature to those discussed for Alternative 1.

5.4.3 Effects of Alternative 3 (No Action Alternative)

Under the No Action Alternative, none of the proposed actions would be implemented and no impacts to area air quality would occur.

5.4.4 Mitigation Measures

Based on the results of the evaluation discussed above, the common mitigation measures identified in **Section 5.2.2** and **Table 5-1**, specifically *Common Mitigation Measure #3*, would be required to address identified adverse air quality impacts. *Implementation of these measures would reduce the air quality impacts associated with the Preferred Action Alternative and Modified Action Alternative to less-than-significant levels.*

No mitigation measures are necessary or proposed for implementation of the No Action Alternative.

5.5 Noise

5.5.1 Effects of Alternative 1 (Preferred Action Alternative)

Through implementation of Alternative 1, *direct, short-term adverse* impacts to the noise environment would result from activities associated with the proposed projects. Impacts to the noise environment at the BISO would include short-term increases in non-impulse noise associated with construction equipment. However, due to the isolated nature of the project areas, these noise impacts are considered minor and short-term, and would likely only affect BISO users present at or very near the specific project areas. Similar minor short-term non-impulse noise impacts would occur from time to time throughout the life of the project during maintenance periods.

5.5.2 Effects of Alternative 2 (Modified Action Alternative)

Implementation of Alternative 2 would have similar impacts to the local noise environment as Alternative 1.

5.5.3 Effects of Alternative 3 (No Action Alternative)

Implementation of Alternative 3 would have no effects on the current local noise environment. Operations at the BISO would continue under current conditions.

5.5.4 Mitigation Measures

Based on the results of the noise effects evaluation discussed above, minimal specific mitigation measures are required for implementation of the proposed actions under both the Preferred Action Alternative and the Modified Action Alternative. In order to minimize potential adverse impacts to BISO users, the NPS will:

- Schedule construction and maintenance of the proposed projects so as to minimize impacts to current recreational land use, including use of trails and associated staging areas. If this is determined to not be possible, the NPS will plainly indicate, to potential users of such trails and other areas, that the project areas proposed for construction are to be avoided as necessary.

Implementation of these measures, in addition to those identified in ***Table 5-1****, would reduce the identified impacts associated with the Preferred Action Alternative and Modified Action Alternative to less-than-significant levels.*

No mitigation measures are necessary or proposed for implementation of the No Action Alternative.

5.6 Geology, Topography and Soils

5.6.1 Effects of Alternative 1 (Preferred Action Alternative)

Geology, topography, and soils would potentially sustain both *direct short-* and *long-term adverse* impacts from the implementation of Alternative 1. Impacts to the geology in the project area would likely be negligible, if any, as a result of Alternative 1. Topography and soils would sustain *direct long-term adverse impacts* in the immediate area within the project sites and *direct short-term adverse impacts* in adjacent areas.

During initial project implementation, short-term soil erosion and sedimentation impacts would be possible as land is cleared and regraded and treatment systems are constructed. Construction would remove vegetative cover, disturb the soil surface, and compact the soil. The soil would subsequently be susceptible to erosion by wind and surface runoff. Exposure of the soils during construction would be expected to result in increased sedimentation of the adjacent tributaries of the BSF. Long-term impacts would include:

- Changes in topography due to regrading and construction of wetland treatment systems;
- Removal of soil from areas of excavation associated with the construction of wetland treatment systems; and
- Removal of topsoil in some areas of regrading.

5.6.2 Effects of Alternative 2 (Modified Action Alternative)

Effects of Alternative 2 would be similar in nature to the effects of Alternative 1.

5.6.3 Effects of Alternative 3 (No Action Alternative)

Implementation of Alternative 3 would have no impacts on the geology, topography, and soils of the project area.

5.6.4 Mitigation Measures

Based on the results of the evaluation discussed above, the common mitigation measures identified in **Section 5.2.2** and throughout **Table 5-1** are required to address identified adverse impacts to area geology, topography, and soils as associated with implementation of the Preferred Action Alternative and the Modified Action Alternative. Successful implementation of these measures will ensure that the proposed actions are in compliance with all state and federal standards and minimize both the short- and long-term potential for erosion and sedimentation.

Implementation of these measures would reduce the identified impacts associated with the Preferred Action Alternative and Modified Action Alternative to less-than-significant levels.

As no change in use or configuration of the BISO is associated with implementation of Alternative 3, no mitigation measures would be required.

5.7 Ground and Surface Water Resources

5.7.1 Effects of Alternative 1 (Preferred Action Alternative)

Implementation of Alternative 1 would result in *direct short-term* and *long-term impacts* to surface water resources in the project area and subsequently the receiving waters of the BSF. Streams adjacent to the project sites could incur *short-term negative impacts* such as sedimentation and increased turbidity during construction and *long-term positive impacts* such as improved water quality. Construction of treatment facilities within floodplain areas (see **Section 4.7.5)** would result in a potential *long-term negative* impact to this resource at the Blue Heron, Nancy Graves, Devil's Creek, and Slavey Hollow project sites.

Waterbodies potentially affected by the implementation of Alternative 1 include:

- Laurel Branch;
- Devils Creek;
- Three West Hollow stream;
- Blair Creek;
- Discharge from Worley Mine #88;
- Worley Branch (at Mine #86);
- Slavey Hollow stream;
- Nancy Graves stream; and
- The main body of the BSF.

The BSF and tributary streams of the BSF would sustain *long-term positive* effects from the implementation of Alternative 1. Initial implementation and construction of the proposed project activities could potentially cause *short-term negative impacts* and *long-term positive impacts* to adjacent streams with respect to sedimentation and turbidity; however, in the long-term, the treatment systems and settling ponds will decrease sediments and CMD contaminants entering the BSF. Specific effects of the proposed actions are described below.

Laurel Branch
As discussed in **Section 2.1.1.1**, Laurel Branch is impacted by partially pyrolized mine spoils located along the stream channel. By installing culverts through the mine spoils, the stream water would not come into contact with the spoils, and subsequently not become impacted by CMD. As a result of implementing this proposed action, approximately 120 feet of the Laurel Branch would receive limited atmospheric exposure and thus limited potential for biotic action. However, as compared to the existing conditions of the stream, this (limited atmospheric exposure) is considered a minor adverse impact.

To prevent subsurface water from flowing through the mine spoils upstream of the proposed culverts (near the confluence with the BSF), the NPS proposes to install an HDPE liner or construct a cut-off trench. This would prevent subsurface flow through the mine spoils from entering the stream. This would allow downstream reaches of the stream to recover. Water quality of Laurel Branch would be expected to sustain *long-term positive* effects as a result of the proposed action. In addition, the Laurel Branch would no longer contribute contaminated waters to the BSF.

Within the area near the Laurel Branch confluence with the BSF, the proposed re-grading efforts and installation of an interceptor trench is anticipated to potentially produce some *short-term, minor adverse* effects during construction activities due to minor potential erosion and sedimentation; however, the overall re-grading and re-configuration of the site is expected to produce *long-term, positive* effects to the water quality of the confluence area and the BSF overall.

Devils Creek

As discussed in **Section 2.1.2**, CMD is entering Devils Creek from diffuse discharge points along the steep spoil-covered side slopes on the northern side of the creek. Implementation of Alternative 1 would prevent CMD from entering Devils Creek. CMD would be collected and treated prior to discharging into Devils Creek. Implementation of Alternative 1 would result in *significant long-term positive* impacts to Devils Creek. Metal concentrations and pH would be expected to decrease, and acidity would be expected to decrease. Iron precipitate would no longer be expected to form on the substrate of the stream channel. Aquatic life would be expected to colonize portions of Devils Creek that are currently devoid of it. In addition, Devils Creek would no longer be contributing CMD to the BSF.

Blair Creek

As discussed in **Section 2.1.4**, the NPS proposes to de-water the mine above the level of the stream and convey the subsequent discharge via a pipe to a wetland treatment system on the north side of Blair Creek. Discharge from this treatment system would flow directly into the BSF. De-watering the mine above the level of the stream would minimize mine waters entering Blair Creek. Therefore, the health of Blair Creek would be expected to improve and sustain *long-term positive* effects.

Worley Mine #88 Discharge

Implementation of Alternative 1, as discussed in **Section 2.1.5**, including installation of a vertical up-flow wetland and adjacent small settling ponds in order to neutralize pH would have *long-term positive* effects on the quality of water entering the BSF from the Mine #88 adit.

Worley Branch

Currently, Worley Branch is being impacted by CMD from the mine adit at Worley Mine #86. With the implementation of Alternative 1 as described in **Section 2.1.6**, the CMD from the Mine #86 adit would be collected and routed through an ALD and a series of constructed wetland cells constructed within the Worley Branch drainage basin. Due to the placement of the treatment cells, the un-impacted Worley Branch would be routed through an approximately 600-foot culvert beneath the wetland treatment cells. As a result of implementing Alternative 1, Worley Branch would no longer receive CMD from Mine #86, but approximately 600 feet of the stream would be routed through a culvert prior to discharging into the BSF. As compared to the present condition of the stream, this (routing through the culvert) is considered a relatively *minor adverse* impact to the stream. As a result of implementing Alternative 1, discharge from the drainage basin to the BSF would be expected to sustain *long-term positive* effects.

Slavey Hollow

As discussed in **Section 2.1.7**, the NPS proposes to collect CMD from the mine adit, preventing it from entering Slavey Hollow. The mine drainage would be passively treated and discharged directly into the BSF. With the implementation of Alternative 1, Slavey Hollow would no longer receive a constant source of water; water flow would be limited to atmospheric precipitation events. Implementation of Alternative 1 would have *long-term positive* effects on the discharge from Slavey Hollow.

Nancy Graves Creek

As discussed in **Section 2.1.8**, the NPS proposes to construct a lined channel to segregate Nancy Graves Creek from contaminated mine spoils. This action would have *long-term positive* effects on the water quality of Nancy Graves creek. The NPS also proposes to treat CMD originating as seeps within the powerline right-of-way through wetland treatment cells. This action would also have *long-term positive* effects on the water quality of Nancy Graves creek.

Big South Fork

Implementation of Alternative 1 would result in *significant long-term positive* impacts on the water quality of selected tributary streams entering the BSF within the project area. However, these streams represent only a fraction of mine-contaminated waters contributing to the BSF. Roaring Paunch Creek, which is considered "impaired" due to its relatively low pH, is a much larger contributor to the BSF than the relatively small tributary streams that would be affected by the implementation of Alternative 1. As a result of implementing Alternative 1, the BSF would be expected to sustain *positive, yet relatively minor* effects.

5.7.2 Effects of Alternative 2 (Modified Action Alternative)

In general, implementation of Alternative 2 would have similar *short- and long-term* impacts to ground and surface water resources as those identified for Alternative 1.

Generally, water quality would be improved as a result of implementation of the CMD remediation measures associated with Alternative 2. The alternative configurations of the proposed remediation measures as associated with the Modified Action Alternative would not be expected to result in significantly different effects to water resources, including water quality; the primary differences between Alternatives 1 and 2 are associated with logistical considerations during construction periods. Of these logistical considerations, implementation of Alternative 2 at the Mine #88 area would involve sealing the mine entry and directing additional water to the Mine #86 adit and treatment system. This would increase the discharge of Mine #86 and potentially other discharge points, but would result in less disturbance, and perhaps greater effectiveness of treatment, to the Mine #88 CMD discharge. As such, a *long-term positive* impact is anticipated

5.7.3 Effects of Alternative 3 (No Action Alternative)

Implementation of Alternative 3 would have no new impacts to ground and surface water resources at the BISO. CMD contributions to streams within the project area would continue to result in poor water quality and lifeless stream reaches throughout the project area.

5.7.4 Mitigation Measures

Based on the results of the evaluation discussed above, specific mitigation measures are required for implementation of certain proposed actions under both the Preferred Action Alternative and the Modified Action Alternative. In addition to the common mitigation measures identified in **Section 5.2.2** and throughout **Table 5-1**, specific mitigation measures that are required to address identified adverse impacts to area water resources are summarized as follows:

- The NPS will initiate consultation with the appropriate authorities in McCreary County (and potentially FEMA) for documentation of floodplain impacts at the Blue Heron, Nancy Graves, Devil's Creek, and Slavey Hollow project sites, in accordance with the provisions of EO 11988.
- Wetland areas will be avoided unless there is no feasible alternative. As final designs for the proposed remedial actions become available, the NPS will perform comprehensive jurisdictional wetland delineations (as necessary) covering all proposed project areas and will obtain applicable federal and state permits if jurisdictional wetlands are proposed to be impacted by implementation of the proposed projects. Short-term and long-term direct and indirect impacts to wetlands and aquatic habitats will be minimized through erosion control measures implemented during construction and operation of the facilities.

Successful implementation of these measures will ensure that the proposed actions are in compliance with all state and federal standards and minimize both the short- and long-term potential for erosion and sedimentation. *Implementation of these measures, in addition to those identified in* ***Table 5-1****, would* *reduce the identified impacts associated with the Preferred Action Alternative and Modified Action Alternative to less-than-significant levels.*

As no change in use or configuration of the BISO is associated with implementation of Alternative 3, no mitigation measures would be required.

5.8 Biological Resources

5.8.1 Effects of Alternative 1 (Preferred Action Alternative)

In general, the proposed actions associated with Alternative 1 would have *minor short and long-term negative* impacts to existing terrestrial communities within the boundaries of the project sites. Construction of the proposed projects under Alternative 1 would result in direct impacts to forested communities within the project sites and along access routes at the BISO. With the exception of the Blue Heron Spoils Site, which is covered by seeded grasses and planted pines, approximately one to two acres of natural vegetation would be disturbed at each project site. As discussed in **Section 4.8.2**, most forest stands are 2nd or 3rd growth. The majority of access roads have been sited along existing roads and trails to minimize impacts to the existing environment. Following construction activities, all temporarily disturbed areas would be allowed to revert to pre-existing conditions. Due to the relatively small extent of permanent disturbance (22 acres is less than .02 percent of the overall BISO area), impacts to terrestrial forest resources are considered minor.

Wildlife inhabiting the project area would sustain *minor short-term negative* impacts with the implementation of the proposed projects. Wildlife would be directly impacted during construction by potential displacement, and indirectly impacted, through noise and additional human presence in the area. Less mobile species of mammals, reptiles, and amphibians would possibly be killed or injured by logging and earth-moving equipment; however, most mammals, birds, and other species would vacate the area upon initial construction activities. More mobile animals would be displaced by construction activities into adjacent habitats. In addition, erosion and sedimentation caused by earth-moving activities could adversely affect aquatic life in adjacent streams; however, most streams adjacent to the project sites contain very little, if any, aquatic life due to existing CMD contamination.

Following construction activities, wildlife would be expected to return to the project area provided adequate habitat exists. Aquatic and terrestrial wildlife in the vicinity of the project sites would be expected to sustain *long-term beneficial* impacts from improved water quality that would result from the proposed actions. In general, the biological integrity of the BISO would sustain *long-term beneficial* impacts.

Federally threatened and endangered species identified by the USFWS as having the potential to sustain negative impacts from the implementation of the proposed project include one mammal, one fish, six mussels, and two plants (see **Table 4-3**). The duskytail darter potentially occurs in the BSF upstream of the project area; therefore it would not be expected to be impacted by the proposed project activities. The six species of endangered mussels that are known to occur in the BSF are not currently present in the project area; therefore, no short-term effects on these mussels would be expected. In the long-term, these and other rare mussels would potentially benefit from the proposed projects, as a result of improved water quality of tributary streams entering the BSF. In general, threatened and endangered species could sustain *long-term beneficial* impacts as a result of implementing Alternative 1, primarily due to improved water quality. It is unlikely that any federally-listed species would sustain negative impacts from the implementation of the Alternative 1 activities.

As discussed in **Section 2.0**, this project involves constructing wetlands rather than utilizing existing wetlands. As a result, wetland species such as various birds, reptiles, and amphibians, could benefit from additional wetland habitat in the project area. Several studies have documented that wetlands treating mine drainage provide valuable habitat to many wildlife species without negative impacts on their populations (http://www.enviromine.com/wetlands/risk.htm). Furthermore, the construction of additional wetland areas within the BISO would be expected to result in *long-term positive* impacts to area ecosystems.

5.8.2 Effects of Alternative 2 (Modified Action Alternative)

Implementation of Alternative 2 would have similar impacts to biological resources as those identified for Alternative 1, with a single exception. The implementation of Alternative 2 at the Worley Mine #88 site, including not placing treatment systems at this location, would have lesser impacts to vegetation resources and habitat than Alternative 1. This impact, though *positive*, would be expected to be negligible.

5.8.3 Effects of Alternative 3 (No Action Alternative)

Implementation of Alternative 3 would have no new impacts to biological resources at the BISO. CMD contributions to streams within the project area, including the BSF, would continue to result in poor water quality and aquatic integrity throughout the project area; stream health would not improve in the foreseeable future.

5.8.4 Mitigation Measures

Based on the results of the evaluation discussed above, specific mitigation measures are required for implementation of certain proposed actions under both the Preferred Action Alternative and the Modified Action Alternative. In addition to the common mitigation measures identified in **Section 5.2.2** and throughout **Table 5-1**, specific mitigation measures that are required to address identified adverse impacts to area biological resources are summarized as follows:

- Prior to implementation of any proposed actions, wooded areas that would be impacted by the proposed project will be examined for potential Indiana bat habitat. Disturbance of suitable habitat (i.e., trees with exfoliating bark, dead limbs and cavities) will be avoided between March 31 and October 15 if it is believed that the Indiana bat potentially uses these resources.
- Prior to project implementation, project sites will be inspected to ensure that the two threatened plant species that are known to occur in the general area do not occur within the project sites and would not be impacted by the proposed project activities.
- The NPS will ensure that any standing timber or brush clearing is conducted in accordance with sound ecological practice procedures outlined for such activities.

Successful implementation of these measures will ensure that the proposed actions are in compliance with all state and federal standards and minimize both the short- and long-term potential for erosion and sedimentation. *Implementation of these measures, in addition to those identified in **Table 5-1**, would reduce the identified impacts associated with the Preferred Action Alternative and Modified Action Alternative to less-than-significant levels.*

As no change in use or configuration of the BISO is associated with implementation of Alternative 3, no mitigation measures would be required.

5.9 Cultural Resources

As described in **Section 4.9**, cultural resources are subject to review under Federal and state laws and regulations. Section 106 of the NHPA of 1966 empowers the ACHP to comment on federally initiated, licensed, or permitted projects affecting cultural sites listed to, or eligible for inclusion to, the NRHP. Section 106 requires that all Federal agencies take into account what effects, if any, their actions would have on significant prehistoric archaeological, historic archaeological, or historic resources [5].

Only "significant" cultural resources warrant consideration with regard to adverse impacts resulting from implementation of a proposed action. Those resources that have not been evaluated for significance are considered potentially eligible for listing to the NRHP, pending evaluation, and are therefore considered potentially significant. Generally, cultural resources must be more than 50 years old to receive protection under Federal laws.

The Kentucky SHPO was contacted to provide comment on the potential for the proposed actions to impact cultural resources potentially eligible for listing in the National Register of Historic Places. The SHPO has reviewed the proposed actions in accordance with Section 106 of the NHPA and the regulations of the ACHP (36 CFR Part 800). A copy of the correspondence with this agency related to this project is presented in **Appendix C**.

5.9.1 Effects of Alternative 1 (Preferred Action Alternative)

According to the Kentucky SHPO, the proposed project has a potential to affect cultural resources in the project area. As discussed in **Section 4.9.2**, architectural and archeological resources occur throughout the BISO and within the project area. Specifically, the Worley Mine # 86 site potentially contains features eligible for listing in the National Register of Historic Places, and sites along the BSF could be archeologically significant.

5.9.2 Effects of Alternative 2 (Modified Action Alternative)

Implementation of Alternative 2 would have similar impacts to cultural resources as those identified for Alternative 1.

5.9.3 Effects of Alternative 3 (No Action Alternative)

As no change in use or configuration of the BISO is associated with Alternative 3, implementation of this alternative would not directly produce impacts to cultural resources.

5.9.4 Mitigation Measures

Based on the results of the evaluation discussed above, specific mitigation measures for impacts to potentially significant cultural resources within the project area would be required for implementation of either Alternative 1 or 2. Both alternatives contain areas that have not been surveyed for archaeological resources, and therefore the potential impacts to these resources is unknown. These areas require a Phase I archaeological investigation prior to project implementation. In addition, if potentially significant cultural resources are discovered during earth-moving activities associated with this project, the BISO cultural resources personnel will consult with the SHPO to determine appropriate mitigation.

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[5] Once cultural resources have been identified through a Phase I archaeological survey, the significance of these sites must be determined. If a site's NRHP eligibility cannot be determined from the Phase I survey data alone, a second phase of investigation would be warranted to formally identify a site's NRHP eligibility. Specifically, a Phase II evaluation is designed to formally evaluate a site's eligibility for nomination to the NRHP.

Prior to project implementation, the NPS will complete Phase I archeological surveys within the project area. Results of these surveys will be submitted to the SHPO for review and potential mitigation requirements.

Mitigation measures that would be required to address identified potential adverse impacts to cultural resources sites include the following:

- Prior to ground-breaking activities *on sites that have not been subjected to a prior Phase I cultural resources investigation*, the NPS will ensure that Phase I and, if necessary Phase II, archeological studies are completed in the project areas, as identified above. If significant cultural resources are discovered within the project areas, the NPS will consult with the Kentucky SHPO to determine potential additional courses of action or mitigation (see below). In addition, if upon initiating construction of the proposed projects, potential archeological sites are discovered, the NPS will contact the SHPO for further consultation and mitigation requirements, if any.

- Prior to ground-breaking activities *on sites that have been subjected to a prior Phase I cultural resources investigation and been found to contain a potentially significant cultural resource*, the NPS shall formally consult with the Kentucky SHPO according to the requirements of Section 106 of the NHPA of 1966, as amended, and shall comply with all requirements of the SHPO. In order to ensure that the proposed actions have no adverse effect on NRHP eligible properties, the NPS shall avoid such sites, to the satisfaction of the SHPO, through field marking and fencing as "off-limits" areas. In cases where avoidance of NRHP properties is not possible, the NPS shall initiate the Section 106 process of the NHPA, in consultation with the SHPO and in accordance with 36 CFR Part 800. For each site that cannot be avoided, the NPS shall conduct a Phase II archaeological evaluation to formally establish NRHP eligibility in accordance with Section 106 of the NHPA. Should the Phase II evaluation determine the site to be NRHP eligible and unavoidable, the NPS shall further consult with, and follow the requirements of, the Kentucky SHPO under Section 106 of the NHPA to determine necessary site-specific mitigation, potentially including data recovery, where a percentage of the site is subjected to systematic intensive excavation.

- For each potentially NRHP eligible structural resource located within a proposed project area, the NPS shall inventory and conduct an assessment. If any of these structures are determined to be NRHP eligible, and are further determined to be unavoidable by the proposed actions, the NPS shall consult with the SHPO according to the requirements of Section 106 of the NHPA, as amended, and shall comply with all requirements of the SHPO prior to initiation of any construction activities. Appropriate mitigation measures for structures determined to be significant shall be developed in consultation with the SHPO in accordance with 36 CFR Part 800, the implementing regulation of Section 106 of the NHPA. Most commonly, these measures take the form of HABS/HAER recordation in order to fully document the resource.

- The NPS, in accordance with EO 13175, shall ensure that pertinent federally-recognized Native American tribes are able to review and comment on the proposed actions prior to their implementation as part of this environmental review process.

Successful implementation of these mitigation measures will ensure that the proposed actions are in compliance applicable laws and regulations. *These measures would reduce the identified impacts* *associated with the Proposed Project Alternative and Modified Action Alternative to less-than-significant levels.* No other cultural resources mitigation measures are anticipated.

As no change in use or configuration of the BISO is associated with implementation of Alternative 3, and no new construction would occur that could impact archaeological resources, no mitigation measures would be required..

5.10 Socioeconomics

As discussed in **Section 4.10**, socioeconomic issues include: land area and demographics, local economy, housing, schools, shops and services, recreational facilities, public and occupational health and safety, law enforcement, fire protection, medical facilities, and protection of children.

5.10.1 Effects of Alternative 1 (Preferred Action Alternative)

Of the above-listed socioeconomic issues studied, it has been determined that only recreational facilities would be impacted by Alternative 1, as trail use would be limited during the construction phase of Alternative 1. However, due to the extensive trail system throughout the BISO, this is considered a *negligible short-term impact.*

5.10.2 Effects of Alternative 2 (Modified Action Alternative)

Implementation of Alternative 2 would have identical impacts to socioeconomic resources as those identified for Alternative 1.

5.10.3 Effects of Alternative 3 (No Action Alternative)

As no change in use or configuration of the BISO is associated with Alternative 3, implementation of this alternative would not directly produce impacts to the current socioeconomic environment.

5.10.4 Mitigation Measures

As the impacts identified in conjunction with implementation of Alternative 1 and Alternative 2 are considered negligible, no mitigation measures are required.

As no change in use or configuration of the BISO is associated with implementation of Alternative 3, and no impacts are anticipated, no mitigation measures would be required.

5.11 Environmental Justice

The concept of environmental justice is based on the premise that no segment of the population should bear a disproportionate share of adverse human health or environmental effects of a proposed Federal action. Historically, low-income and minority communities have, in some cases, been disproportionately affected by negative environmental effects, receiving few of the benefits of economic growth and development while absorbing much of the societal cost. In accordance with EO 12898, **Sections 4.10 and 4.11** examined the demographic profile of the population around the project area. Included in this section is a determination as to whether either the Preferred Action or the Modified Action Alternative has the potential to adversely effect human health and the environment of the areas surrounding the installation, specifically with regard to disadvantaged populations.

5.11.1 Effects of Alternative 1 (Preferred Action Alternative)

McCreary County was noted in **Section 4.11** to have an at-or-below poverty level demographic of approximately 35.3%. However, no disproportionate adverse effects to the economically disadvantaged population segments of McCreary County are expected from implementation of Alternative 1, as environmental impacts are anticipated to be contained within the BISO boundary.

5.11.2 Effects of Alternative 2 (Modified Action Alternative)

Implementation of Alternative 2 would have identical impacts to environmental justice as those identified for Alternative 1; no disproportionate adverse impacts related to the social, economic, physical, environmental, or health standards of any particular subsistence-based or minority population are expected under the Modified Action Alternative.

5.11.3 Effects of Alternative 3 (No Action Alternative)

Implementation of Alternative 3 would have no effects on the disadvantaged population segments within McCreary County.

5.11.4 Mitigation Measures

As no impacts to disadvantaged population segments are associated with implementation of Alternative 1, Alternative 2, or Alternative 3, no mitigation measures would be required.

5.12 Infrastructure

As discussed in **Section 4.12**, infrastructure issues generally include: potable water supply, wastewater treatment, solid waste disposal, energy sources, and transportation systems (i.e., roadways, railroads, airports). However, due to the location and nature of the project sites, the only infrastructure issues applicable to this project include roadways (and trails), railroads, and utility rights-of-way.

5.12.1 Effects of Alternative 1 (Preferred Action Alternative)

5.12.1.1 Roads and Trails

Roads and trails would sustain both *direct* and *indirect short-term* impacts as a result of implementing Alternative 1. As discussed in **Section 2.10**, existing roads and trails would be temporarily impacted during the construction phase of the proposed projects. **Figure 1-3** illustrates the five primary access routes required to gain access to the project sites.

Access to the Laurel Branch sites and the Blair Creek site would impact approximately 1.5 miles of the Blair Creek Loop Horse Trail and approximately 0.2 mile of the River Trail. Portions of these trails would be widened to approximately 20 feet to allow equipment access to the Blair Creek and Laurel Branch sites. As proposed, permanent erosion control measures would be installed following construction along these trails. Also following construction, additional area that was cleared to widen the trails would be seeded to ensure revegetation. Access for minor maintenance of the remedial systems at the Laurel Branch and Blair Creek sites would likely be required approximately every 2 to 3 years.

Access to the Worley Mine #86 site would be accomplished via an existing, unimproved, public road. From the Worley Mine #86 site, the Worley Mine #88 site would be accessed along the Big South Fork Scenic Railway right-of-way. The unimproved road leading to the Worley Mine #86 site would be widened to approximately 20 feet and permanently maintained following construction as an access point to the BSF, consequently improving the infrastructure within the BISO. This is considered *a long-term beneficial* impact to the infrastructure at the BISO. Continued maintenance of this road would allow improved access to the BSF. Following construction activities associated with the remediation at Worley Mine # 88, the access route would be returned to pre-construction conditions.

Access to the Nancy Graves and Devils Creek sites would be accomplished via the existing Wilson Ridge Road and primarily pre-existing, unimproved trails and/or mining roads. For the purposes of bringing equipment to the site, trails would be widened to approximately 20 feet. Following construction, permanent erosion control measures would be installed, and the trails would be revegetated at the discretion of the NPS. For maintenance purposes these sites would have to be accessed approximately every 15 to 30 years.

An existing SKRECC powerline crosses the Nancy Graves site. However, this powerline will not be affected by the proposed project activities; therefore no impacts are anticipated.

The Blue Heron Spoils site would be accessed from the Blue Heron parking area via existing trails. Approximately 0.7 mile of the River Trail would be impacted by this access route. The trail would be widened to approximately 20 feet to allow construction equipment access to the site. Following construction, permanent erosion control measures would be installed on these access roads, and they would be revegetated at the discretion of the NPS. A need for continued access to this site is not anticipated.

The Slavey Hollow site would be accessed from Wilson Ridge Road via pre-existing unimproved roads and trails. Approximately 0.7 mile of unimproved roads/trails would be impacted by the access route; These trails/roads would be widened to approximately 20 feet. Based on current iron loading calculations, maintenance of the treatment system at Slavey Hollow would not be required for approximately 80 years; however, the access road would be maintained on an as-needed basis.

5.12.1.2 Railways

As discussed in **Section 2.10**, portions of the Big South Fork Scenic Railroad right-of-way would potentially be impacted by the proposed access routes, via the use of the railroad right-of way to access the Worley Mine #88 project site. However, these impacts are expected to be *short-term, and minor*, as no displacement (or very little displacement) of traffic on the tracks is anticipated.

5.12.2 Effects of Alternative 2 (Modified Action Alternative)

Implementation of Alternative 2 would have identical impacts to BISO infrastructure resources as those identified for Alternative 1.

5.12.3 Effects of Alternative 3 (No Action Alternative)

Implementation of Alternative 3 would have no effects on the current infrastructure within the BISO.

5.12.4 Mitigation Measures

Based on the results of the evaluation discussed above, specific mitigation measures are required for implementation of certain proposed actions under both the Preferred Action Alternative and the Modified Action Alternative. In addition to certain common mitigation measures identified in **Section 5.2.2** and throughout **Table 5-1**, specific mitigation measures that are required to address identified adverse impacts to the BISO infrastructure (though minor) and associated resources are summarized as follows:

- The NPS will coordinate with local governments, as well as county and Commonwealth of Kentucky highway departments with regard to planning any high-intensity usage for ingress and egress of vehicles on roadways in the vicinity of the project area. The NPS will, if directed by the aforementioned regulatory bodies, conduct traffic studies and/or discuss improvements to local roadways that may be necessary to accommodate increases in traffic due to the proposed remediation activities at the BISO.
- The NPS will coordinate with the Big South Fork Scenic Railway to insure that the railroad tracks and Scenic Railway tours are not adversely impacted by the proposed projects.

Successful implementation of these measures will ensure that the proposed actions are in compliance with all state and federal standards and minimize both the short- and long-term potential infrastructure impacts. *Implementation of these measures, in addition to those identified in **Table 5-1**, would reduce the identified impacts associated with the Preferred Action Alternative and Modified Action Alternative to less-than-significant levels.*

As no change in use or configuration of the BISO is associated with implementation of Alternative 3, no mitigation measures would be required.

5.13 Hazardous and Toxic Materials/Wastes

5.13.1 Effects of Alternative 1 (Preferred Action Alternative)

As discussed in **Section 4.13**, no hazardous wastes are generated, stored, handled, transported, treated, or disposed of in the vicinity of the project sites. Therefore, implementation of Alternative 1 would have *no impact* on hazardous wastes within the project area. Partially pyrolized spoil piles within the project area would be graded at selected project sites to help prevent the production of CMD, but no spoils would be removed from the project sites.

5.13.2 Effects of Alternative 2 (Modified Action Alternative)

Impacts associated with the implementation of Alternative 2 would be similar in nature to those identified for Alternative 1.

5.13.3 Effects of Alternative 3 (No Action Alternative)

Implementation of Alternative 3 would have no effects on the partially pyrolyzed spoil piles or the production of CMD in the project area.

5.13.4 Mitigation Measures

As no adverse effects to issues regarding hazardous and toxic materials/wastes storage and/or generation at BISO are anticipated through implementation of Alternative 1, Alternative 2, or Alternative 3, no mitigation measures are required.

5.14 Cumulative Effects

This section addresses the cumulative effects of the proposed actions. Cumulative effects are defined by the CEQ in 40 CFR 1508.7 as:

> "impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions."

The CEQ regulations also state that the cumulative impacts addressed should not be limited to those from actual proposals, but must include impacts from actions being contemplated or that are reasonably foreseeable.

Impacts associated with the implementation of Alternatives 1 and 2 would be primarily associated with water quality. The proposed actions under both Alternatives 1 and 2 would have significant positive impacts on discharge of tributary streams to the BSF. Therefore, the BSF would be expected to sustain minor (possibly negligible), long-term positive impacts. The adverse impacts likely resultant from implementation of the proposed action under Alternative 1 or 2, as identified in **Sections 5.5** through **5.15**, include relatively minor impacts to the forest communities within the project area and potential increases in turbidity and sedimentation during construction activities. However, net positive impacts to water quality and aquatic resources would be realized. In addition, terrestrial resources indirectly would realize positive effects due to improved water quality.

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6.0 COMPARISON OF ALTERNATIVES AND CONCLUSIONS

This EA has evaluated the potential environmental, cultural, and socioeconomic impacts from the proposed remediation activities at several contaminated mine drainage sites within the BISO. The project alternatives include:

- Alternatives 1 and 2: As detailed in **Table 3-1**, these alternatives include implementing remedial actions such as segregating surface waters from partially pyrolized mine spoils, construction wetland treatment systems, and installing ALDs.
- Alternative 3, the No Action Alternative, proposes that the NPS not attempt to remediate areas and streams within the project area adversely affected by partially pyrolized mine spoils and CMD.

6.1 Comparison of the Environmental Consequences of the Alternatives

Implementation of either Alternative 1 or Alternative 2 would result in *long-term beneficial* effects to water and biological resources within the project area. *Short-term adverse* impacts to the local environment would include increased air emissions from vehicles and equipment, noise levels, potential on-site soil erosion and consequent sedimentation of local surface waters, limited recreational use of trails in the project area during construction, and potential impacts to on-site cultural resources. These *short-term adverse* impacts would be lowered to acceptable levels with implementation of the common mitigation measures identified in **Section 5.2.2**, and the resource area-specific mitigation measures identified throughout **Sections 5.3 through 5.13**. Implementation of the proposed actions would not adversely impact geology, topography, ground water resources, socioeconomic resources, environmental justice issues, infrastructure, or hazardous materials and wastes.

Implementation of Alternative 2 would result in similar impacts to those identified for Alternative 1. The alternative configurations of the proposed remediation measures as associated with this Modified Action Alternative would not be expected to result in significantly different effects to water resources, including water quality; the primary differences between Alternatives 1 and 2 are associated with logistical considerations during construction periods. Of these logistical considerations, implementation of Alternative 2 at the Mine #88 area would involve sealing the mine entry and directing additional water to the Mine #86 adit and treatment system. This would negligibly increase the discharge of Mine #86 and potentially other discharge points, but would result in less disturbance, and perhaps greater effectiveness of treatment, to the Mine #88 CMD discharge.

Alternative 3, the No Action Alternative, was not found to satisfy the purpose and need for the project, as no remedial actions would occur under this alternative. Without implementing the proposed actions, CMD will continue to adversely affect local streams within the project area.

Table 6-1 presents a summary of impacts expected from the implementation of Alternatives 1, 2, and 3, including the type and duration of each impact, and identifies issue areas requiring mitigation, correspondent with the detailed discussions provided in **Section 5.0**.

Table 6-1 Summary Descriptions of Impacts Associated with Alternatives 1, 2, and 3

Resource Area	Preferred Action Alternative	Modified Action Alternative	No Action Alternative
Land Use	o□✓▽	o□✓▽	o■
Air Quality	o□✓▽	o□✓▽	∅
Noise	o□✓▽	o□✓▽	∅
Geology, Topography, and Soils	o□■✓▽	o□■✓▽	∅
Water Resources	o□✓▽●	o□✓▽●	•■
Biological Resources	o□✓▽●	o□✓▽●	•■
Cultural Resources	•■✓▽	•■✓▽	∅
Socioeconomics	∅	∅	∅
Environmental Justice	∅	∅	∅
Infrastructure	□✓▽●	□✓▽●	∅
Hazardous and Toxic Materials/Wastes	∅	∅	∅

LEGEND:

∅	No Impact	□	Short-term Adverse Impact
•	Major Adverse Impact	■	Long-term Adverse Impact
o	Minor Adverse Impact	✓	Mitigation Specified
●	Beneficial Impact	▽	No Adverse Impact with Mitigation

6.2 Conclusions

Based on the analysis of potential effects of each of the alternatives, this EA has determined that remediation activities under either Alternative 1 or 2 would result in a net benefit to the natural environment. Activities under Alternatives 1 or 2 would not have a significant adverse individual or cumulative impact on any environmental resources, provided mitigation measures are successfully implemented and upkeep of treatment systems is properly maintained. Under either alternative, positive long-term effects to water and biological resources would be anticipated.

This EA recommends that the NPS elect to implement a combination of the Preferred Action Alternative and the Modified Action Alternative.

Specifically, it is recommended that Alternative 1, the Preferred Action Alternative, be implemented with respect to the following project sites: Laurel Branch Channel, Laurel Branch Confluence, Devils Creek, Blue Heron Spoils, Blair Creek, Worley Mine #86, Slavey Hollow, and Nancy Graves. This EA recommends that the NPS implement Alternative 2, the Modified Action Alternative, with respect to the Worley Mine # 88 site. Implementation of these activities would serve to fulfill the purpose of and need for the proposed action, while minimizing the potential for impact.

7.0 References

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APPENDIX A
Figures

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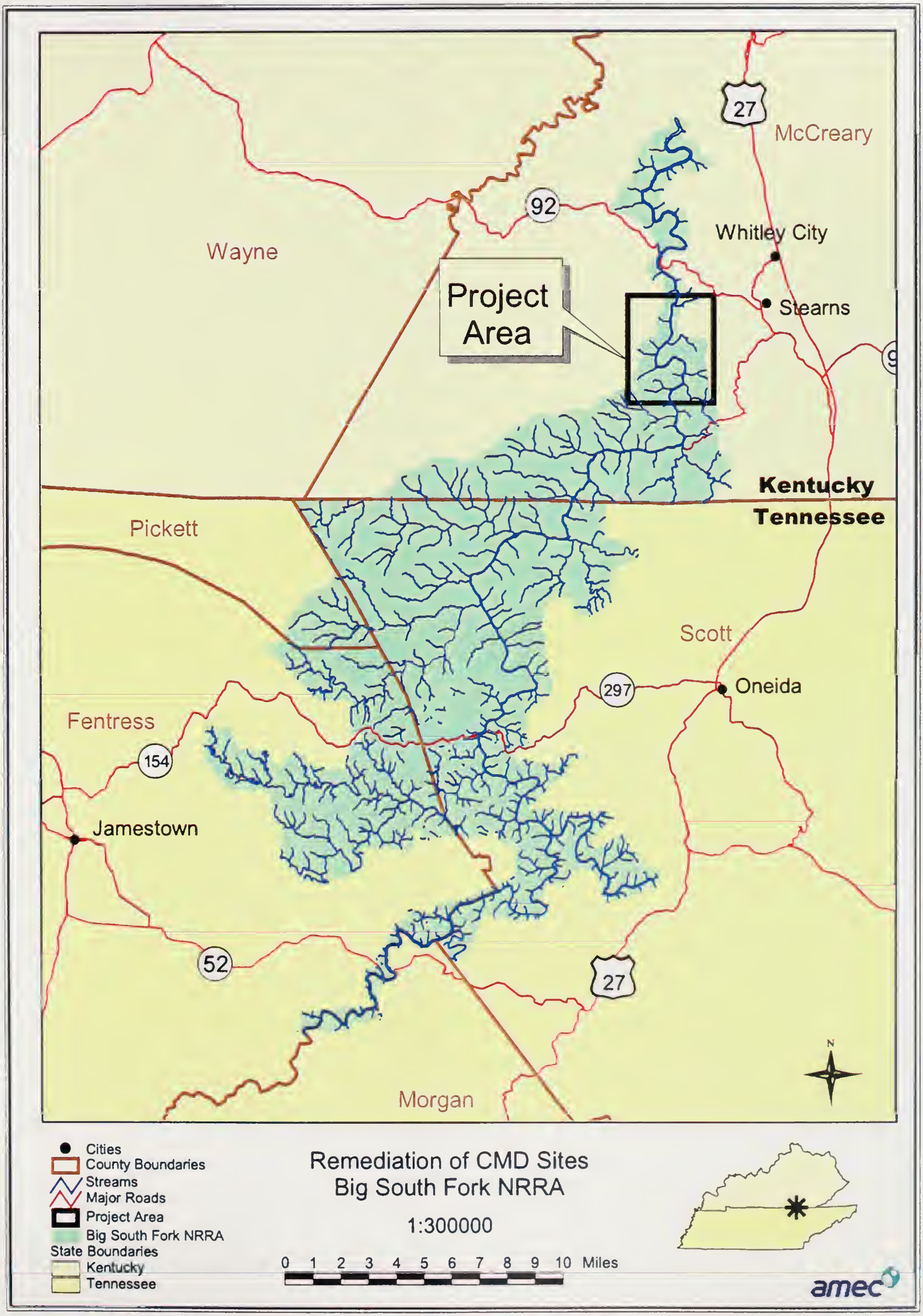


Figure 1-1 Location of the Big South Fork NRRA and Project Area

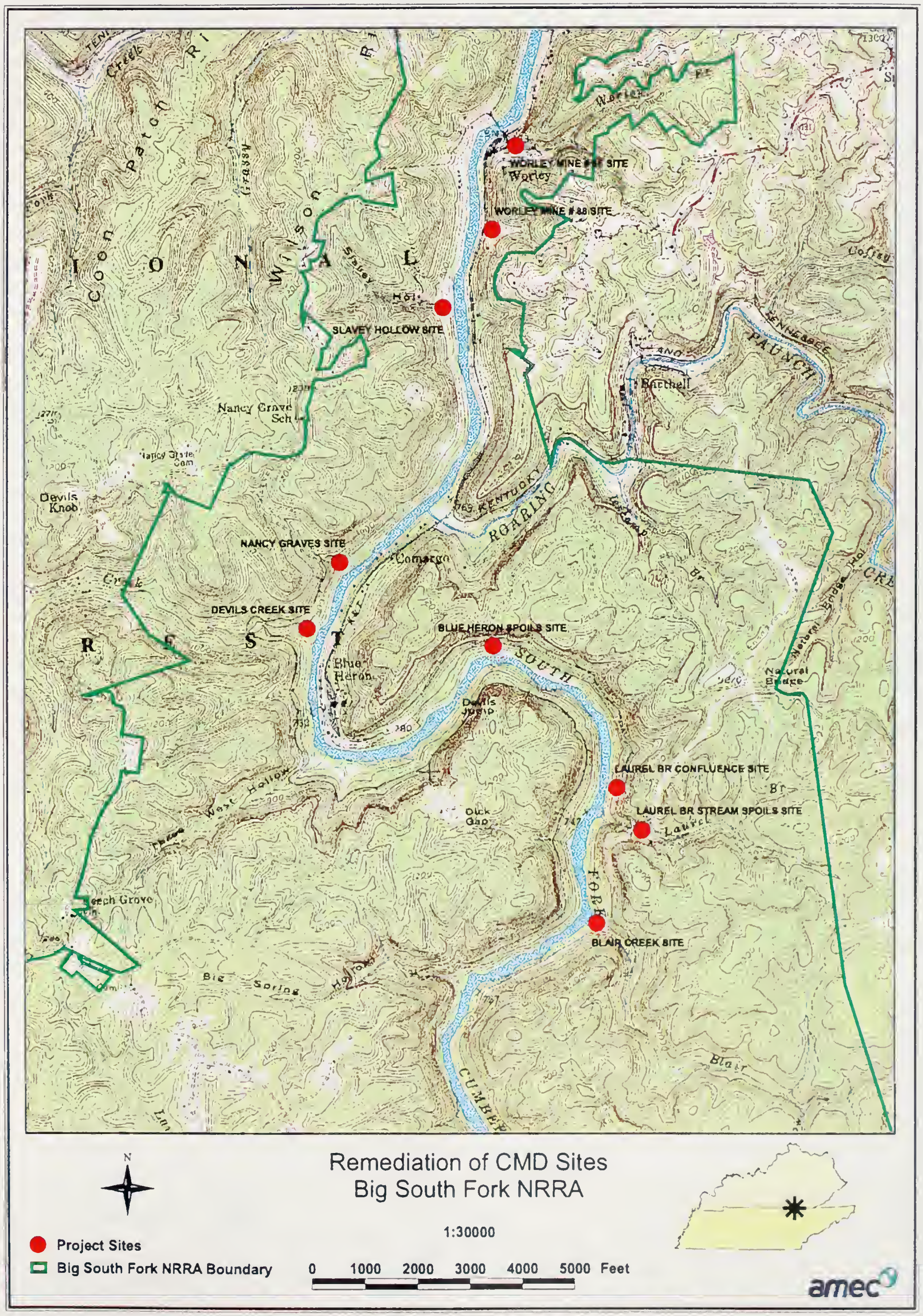


Figure 1-2 Topographic Reference Map for Project Area

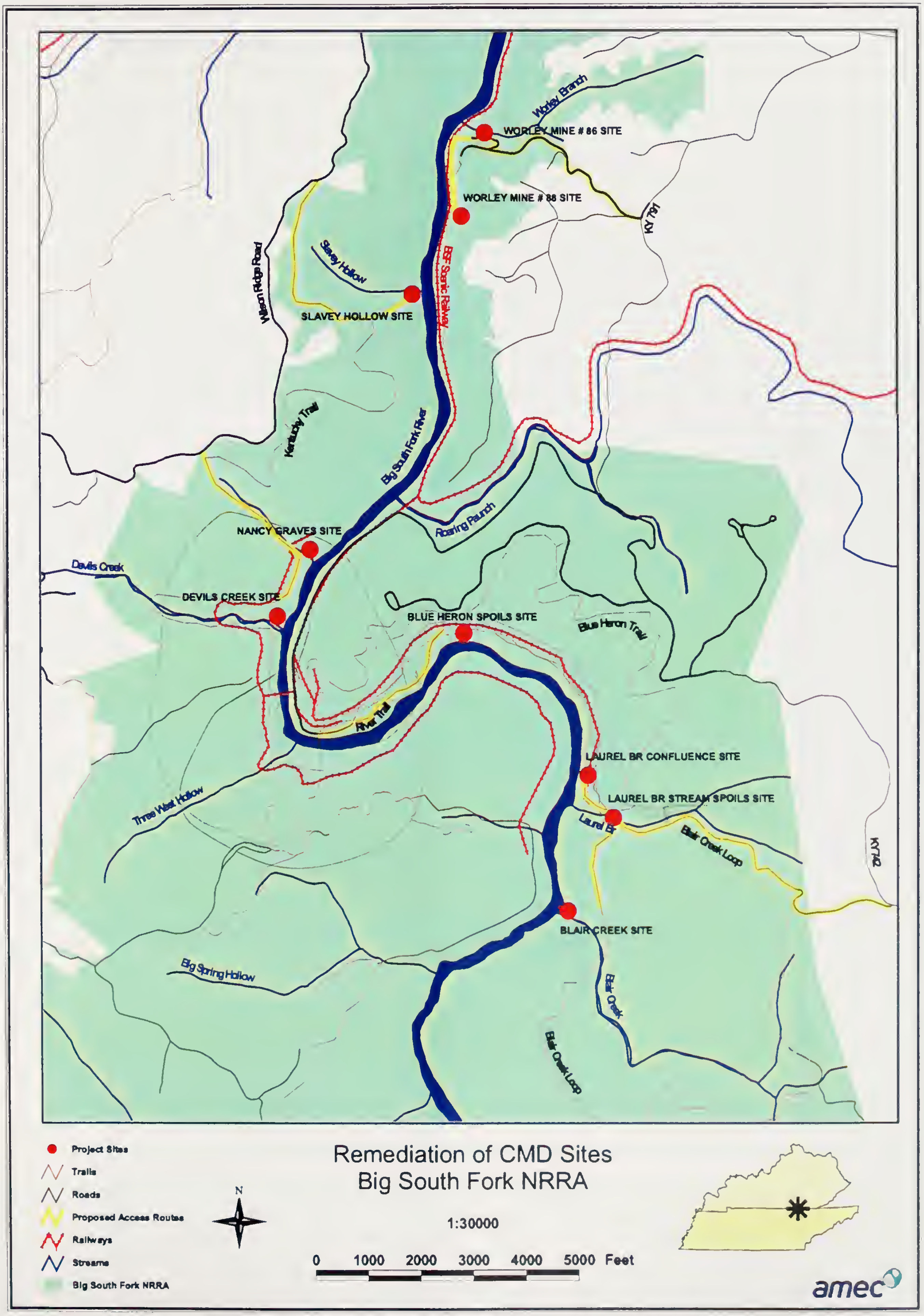
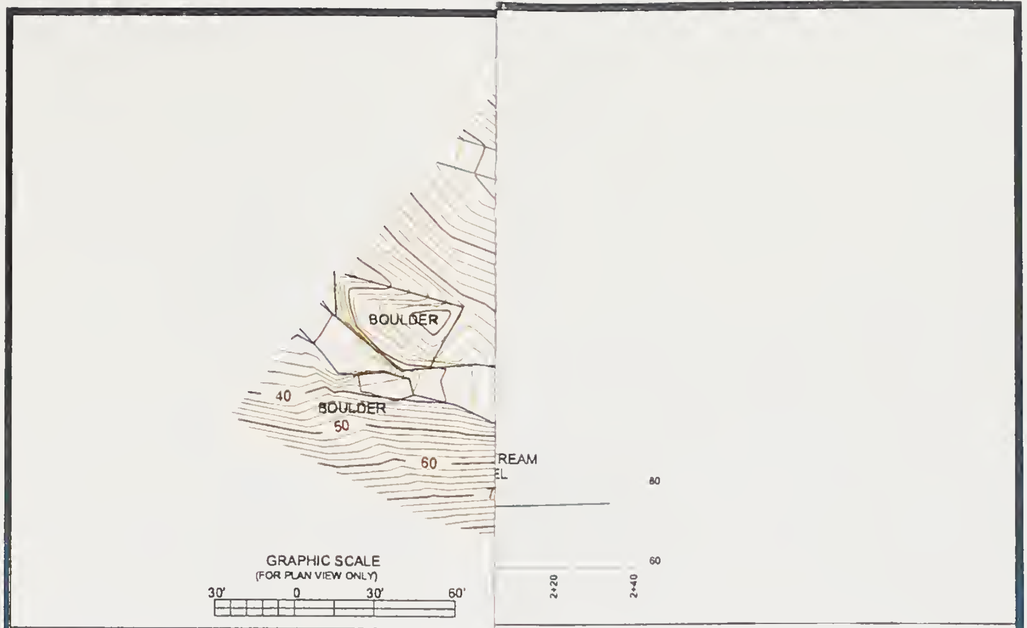
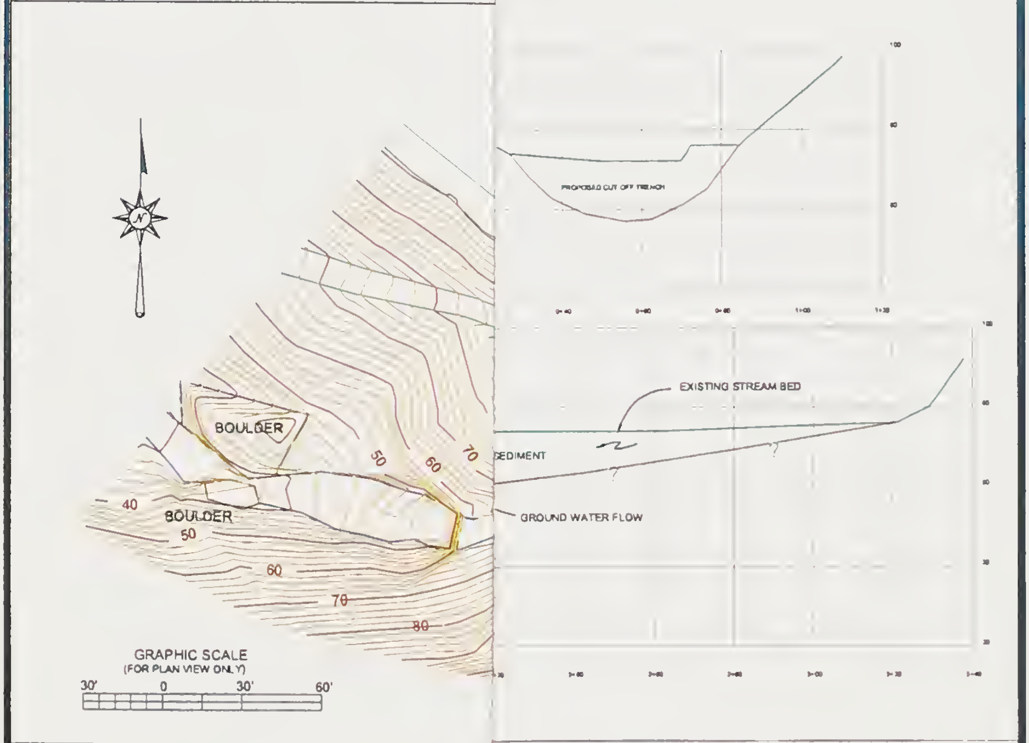
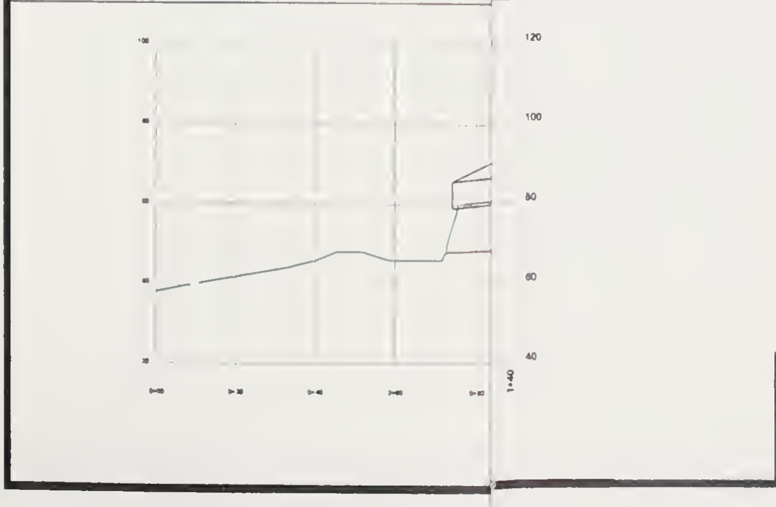


Figure 1-3 Reference Map for Project Sites and Proposed Access Routes







Remediation of CMD Sites
Big South Fork NRRA

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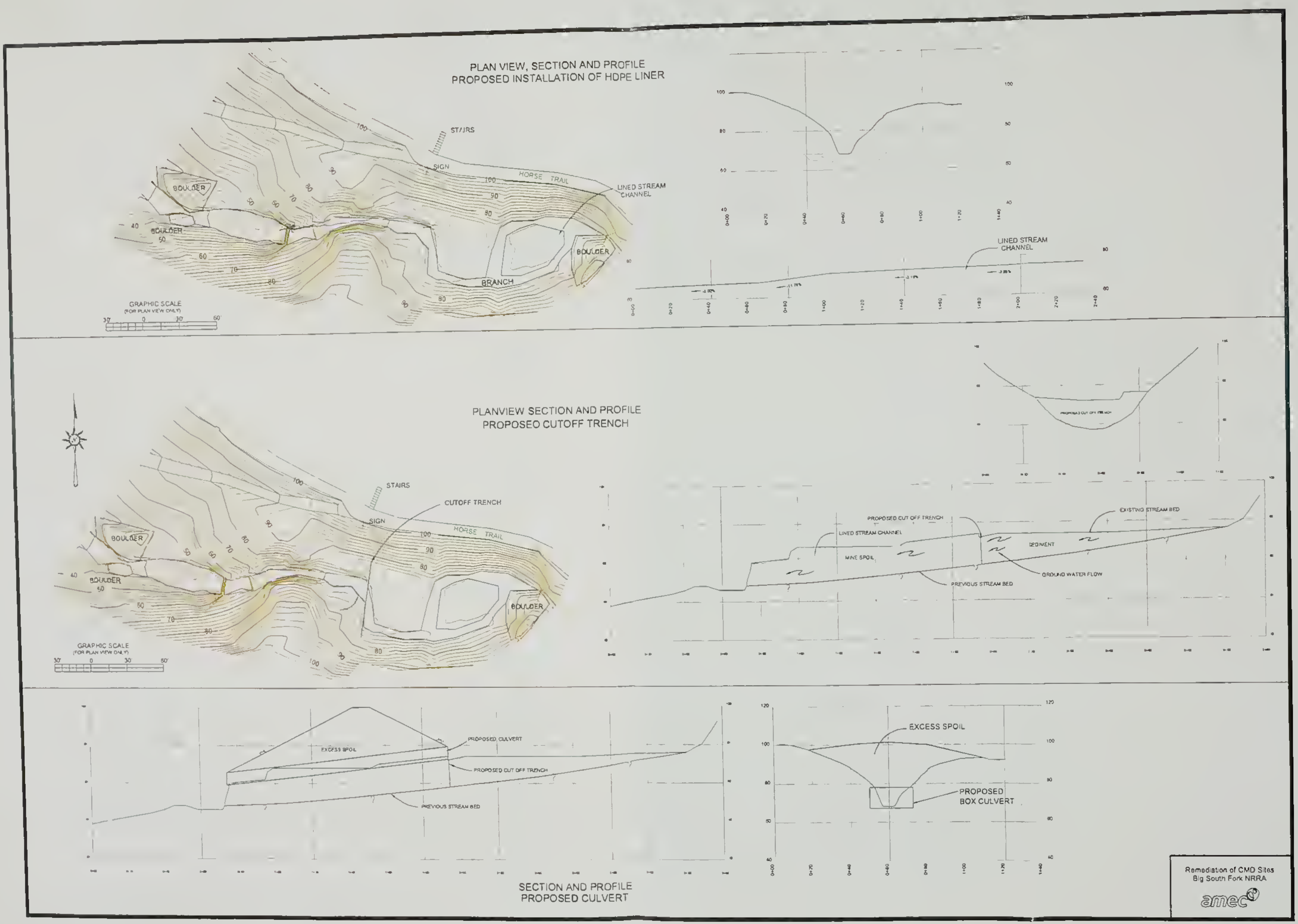

Figure 2-1 Conceptual Drawing of Proposed Actions at the Laurel Branch Spoils Site

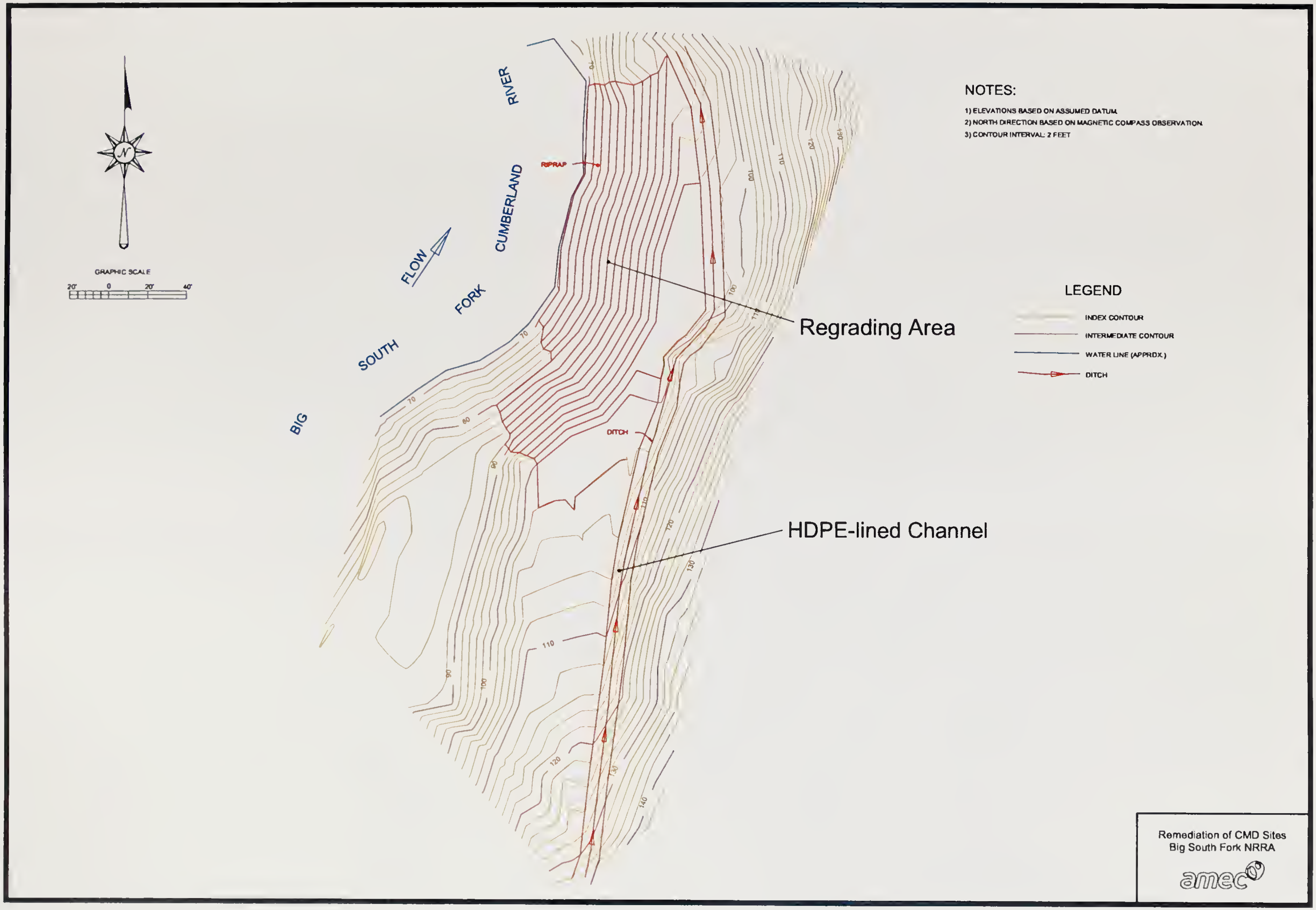

Figure 2-2 Conceptual Drawing of Proposed Actions at the Laurel Branch Confluence Site

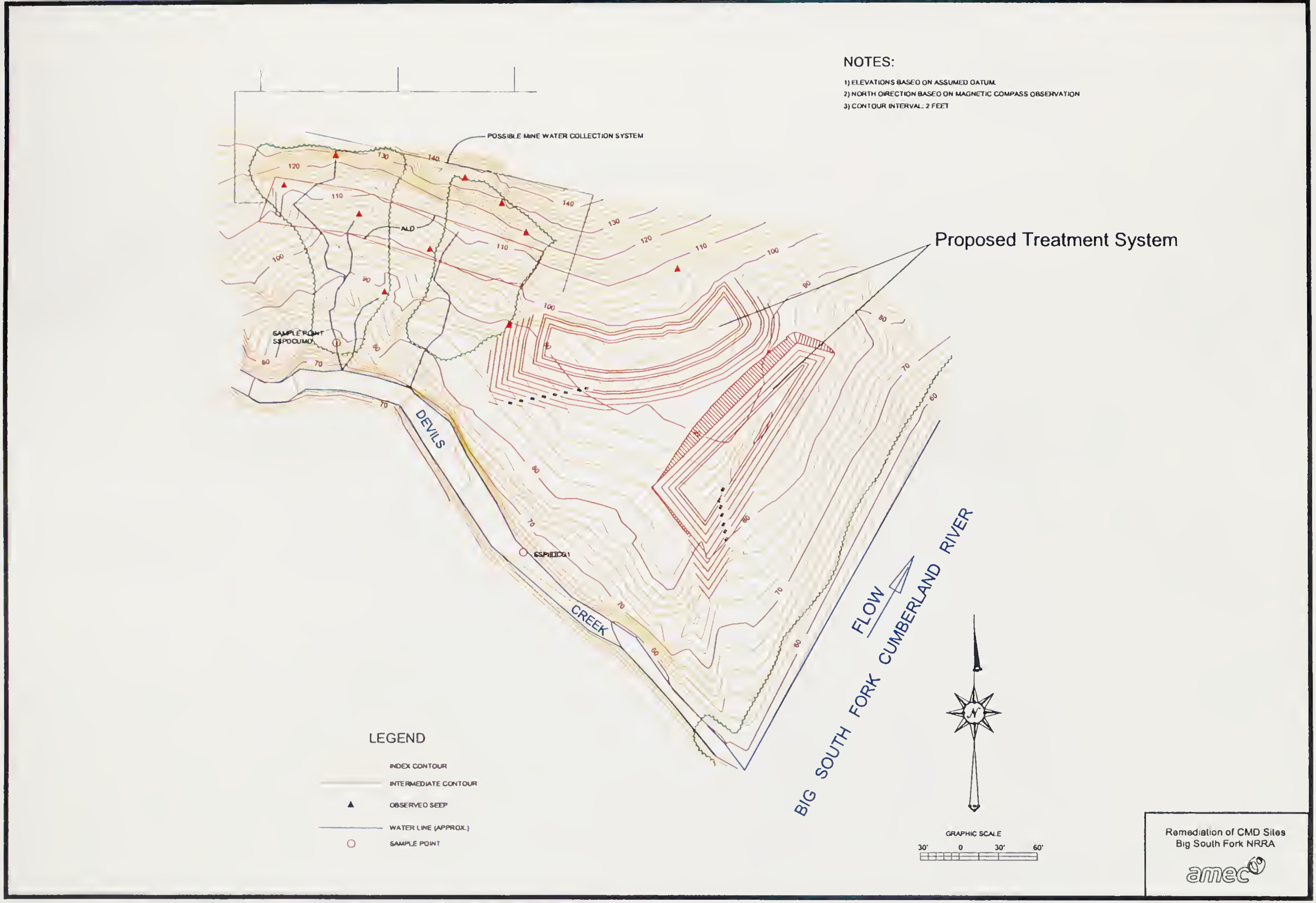

Figure 2-3 Conceptual Drawing of Proposed Actions at the Devils Creek Site

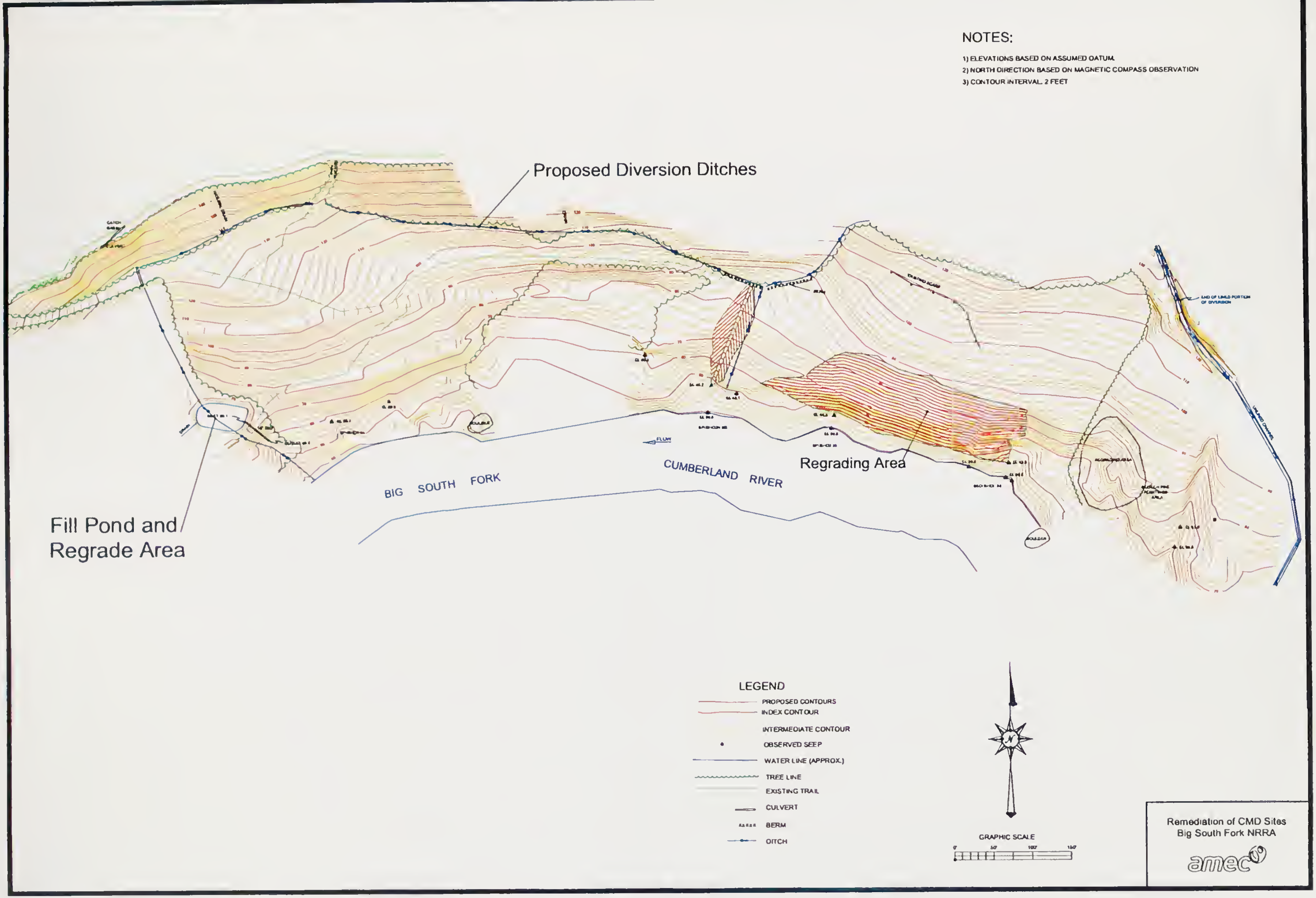

Figure 2-4 Conceptual Drawing of Proposed Actions at the Blue Heron Site

Figure 2-5 Conceptual Drawing of Proposed Actions at the Blair Creek Site

[NOTE: THIS FIGURE HAS BEEN OMITTED FOR THE PRELIMINARY DRAFT EA, AS ENGINEERING DESIGN PLANS ARE IN-PROGRESS AT THIS TIME]

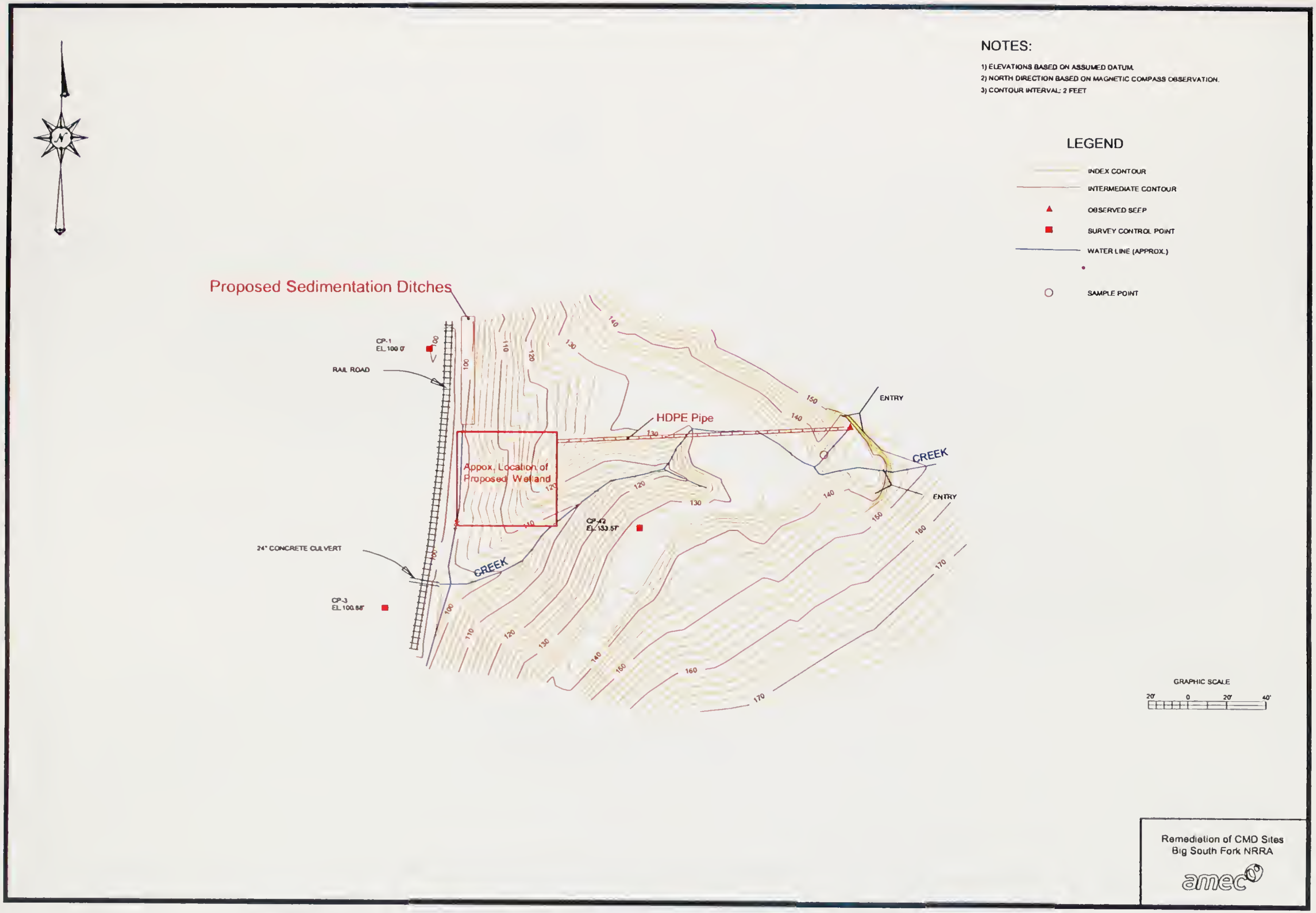

Figure 2-6 Conceptual Drawing of Proposed Actions at Worley Mine #88 Site

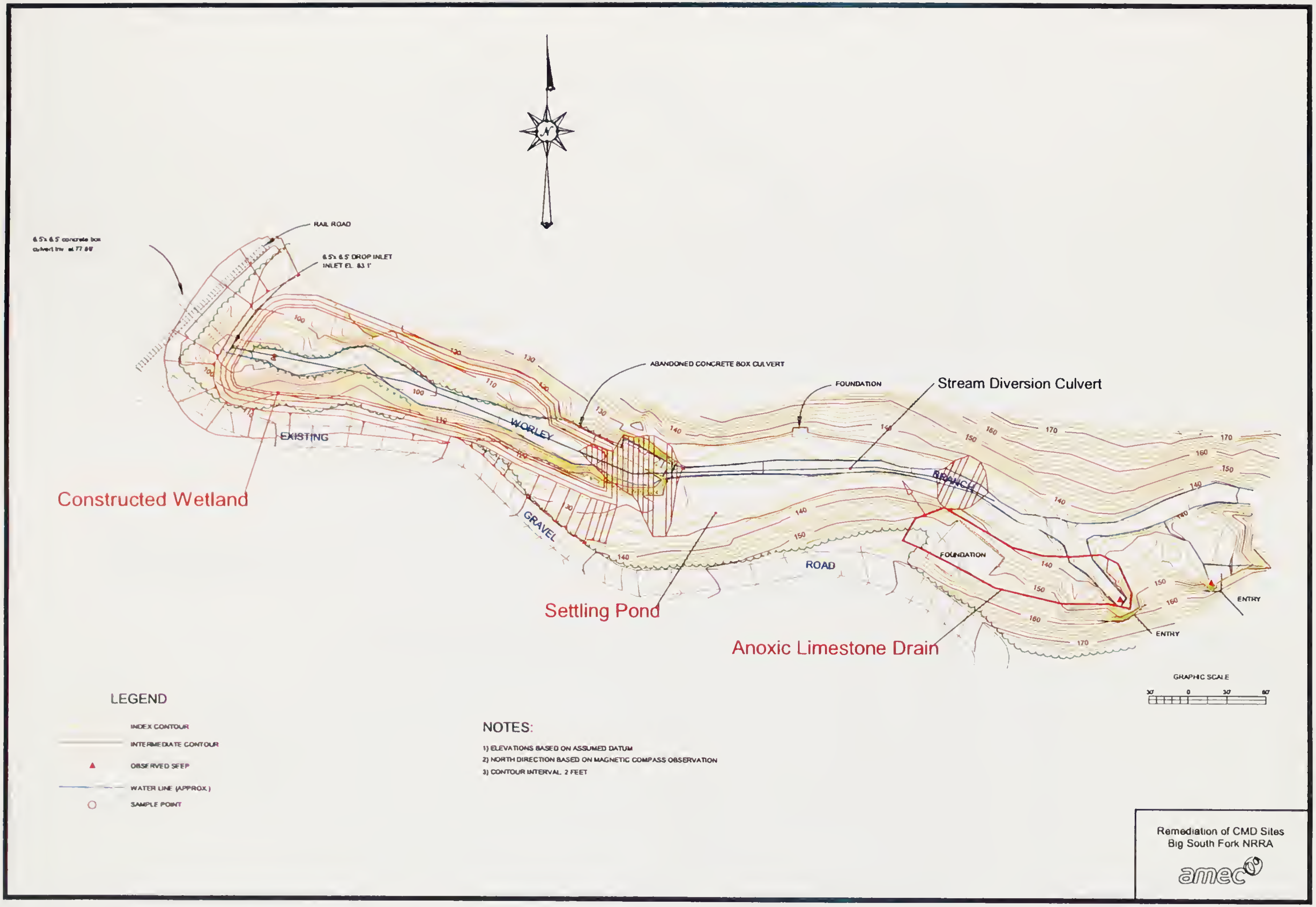

Figure 2-7 Conceptual Drawing for Proposed Actions at Worley Mine #86 Site

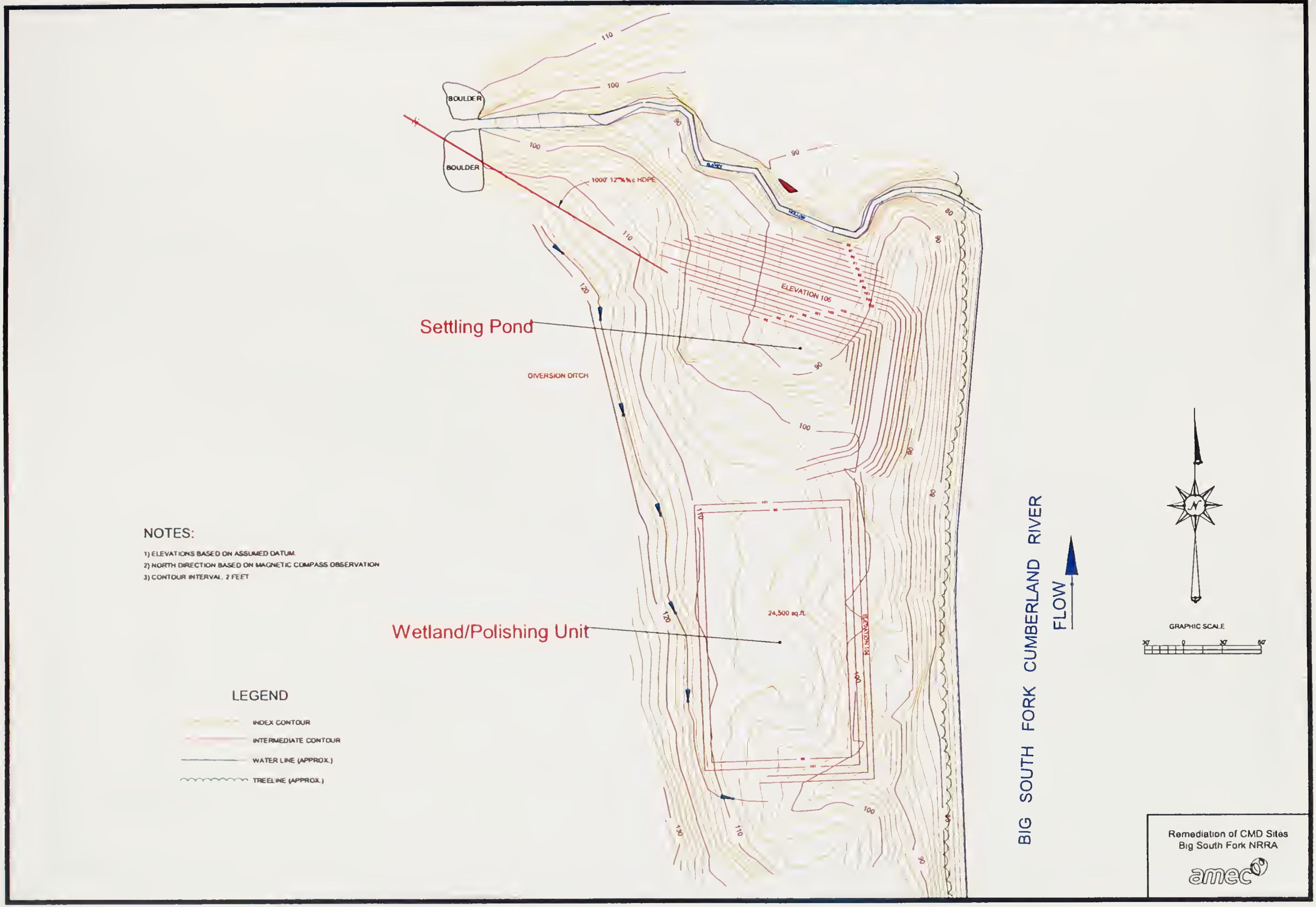

Figure 2-8 Conceptual Drawing of Proposed Actions at the Slavey Hollow Site

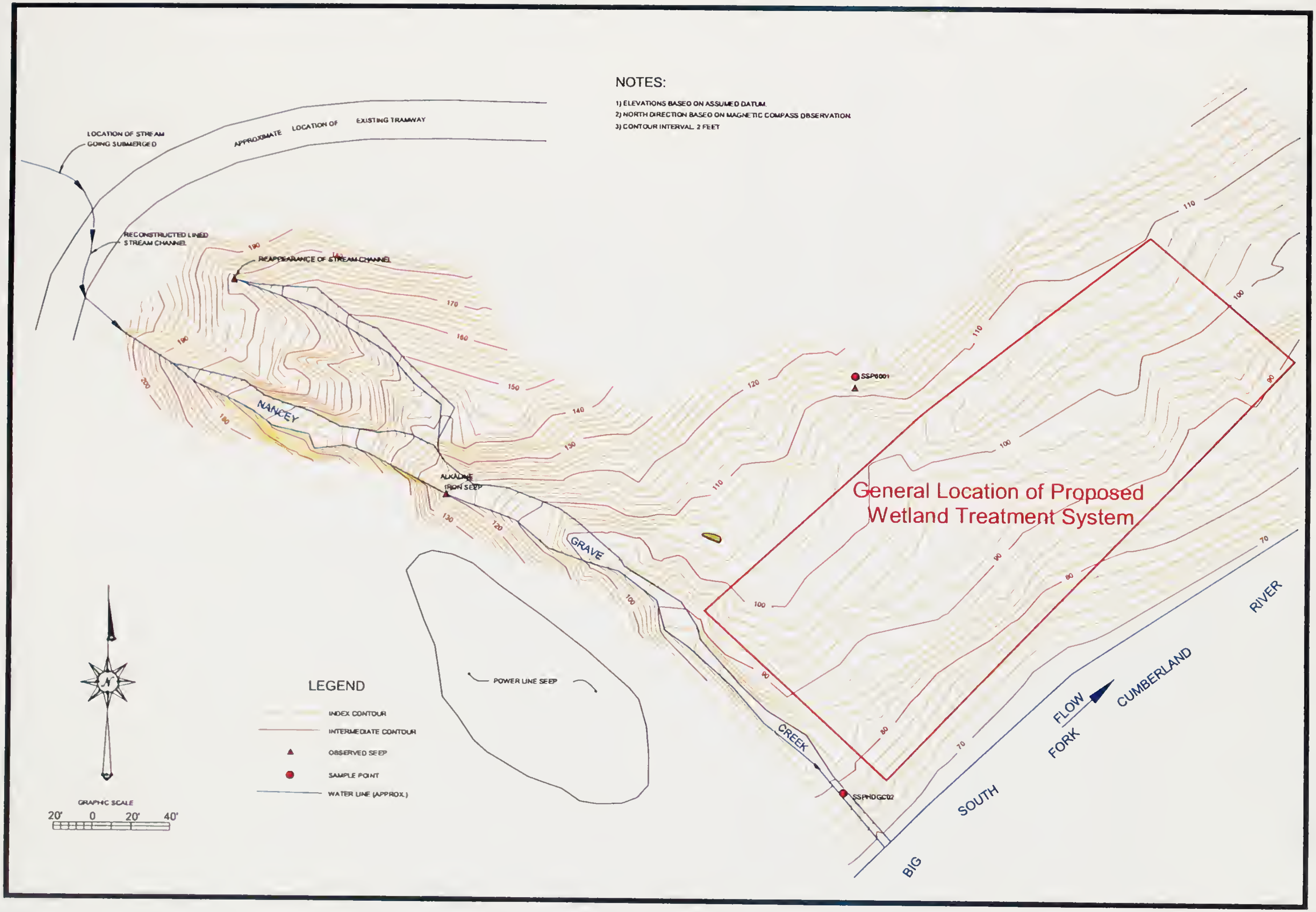
NOTES:
1) ELEVATIONS BASED ON ASSUMED DATUM.
2) NORTH DIRECTION BASED ON MAGNETIC COMPASS OBSERVATION.
3) CONTOUR INTERVAL 2 FEET
LOCATION OF STREAM GOING SUBMERGED
APPROXIMATE LOCATION OF EXISTING TRAMWAY
RECONSTRUCTED LINED STREAM CHANNEL
REAPPEARANCE OF STREAM CHANNEL
ALKALINE IRON SEEP
NANCEY
GRAVE
CREEK
SSP6001
SSPHDGC02
POWER LINE SEEP
General Location of Proposed Wetland Treatment System
BIG SOUTH FORK CUMBERLAND RIVER
FLOW
200
190
180
170
160
150
140
130
120
110
100
90
80
70
LEGEND
INDEX CONTOUR
INTERMEDIATE CONTOUR
OBSERVED SEEP
SAMPLE POINT
WATER LINE (APPROX.)
N
GRAPHIC SCALE
20'
0
20'
40'

Figure 2-9 Conceptual Drawing of Proposed Actions at the Nancy Graves Site

APPENDIX B
Pyrite Oxidation Chemistry

Physical and chemical alterations of streams affected by CMD is often caused by the oxidation of iron pyrite (FeS_2), which is often exposed during mining operations. The chemical reactions associated with the production of CMD were taken from Reed *et al.* 1995. The chemical reaction association with the oxidation of pyrite is provided below.

$$2FeS_2 + 7O_2 + 2H_2O \rightarrow 2Fe^{2+} + 4H^+ + 4SO_4^{2-}$$

The ferrous iron produced by the previous reaction undergoes further oxidation in a wetland system:

$$4Fe^{2+} + O_2 + 4H^+ = 4Fe^{3+} + 2H_2O$$

If sufficient alkalinity is not present to provide a buffering capacity, the hydrolysis of the ferric iron (Fe^{3+}) will further decrease the pH in the wetland effluent:

$$Fe^{3+} + 3H_2O \rightarrow Fe(OH_3) + 3H^+$$

At this time, the ferric hydroxide may remain suspended or settle onto the substrate as a sterile yellowish slime often called "yellow boy".

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APPENDIX C
Agency Correspondence

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amec

FILE

April 5, 2001

United States Fish and Wildlife Service
Cookeville Field Office
446 Neal Street
Cookeville, TN 38501
Attn: Dr. Lee Barclay, Field Supervisor

Re: Intergovernmental and Interagency Coordination of Environmental Planning (IICEP) Consultation for the Environmental Assessment for Remediation of Selected Contaminated Mine Drainages at the Big South Fork National River and Recreation Area, McCreary County, Kentucky.

Dear Dr. Barclay:

AMEC Earth & Environmental Inc. (AMEC) has been contracted by the National Park Service (NPS) to prepare an Environmental Assessment (EA) for the remediation of selected contaminated mine drainages (CMD) at the Big South Fork National River and Recreation Area (BISO), McCreary County, Kentucky (see *Figure 1-1*). The EA is being prepared in strict accordance with the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations implementing NEPA, and NPS NEPA Compliance Guidelines (NPS-12).

The BISO is located on the Cumberland Plateau, northwest of Knoxville, Tennessee in southeastern Kentucky and northeastern Tennessee. The project area includes selected sites located along a 12-mile segment of the Big South Fork of the Cumberland River (BSF) approximately 5 miles north of the Tennessee border (see *Figure 1-1*). The Big South Fork Region has been extensively mined for coal since the turn of the century with some mines still operating in the BSF watershed. These mining activities created at least 120 underground entries within the BISO that are clustered along the various coal seams outcropping from the steep slopes of the BSF river gorge. The waste materials from these mines were generally deposited in uncontrolled dumps near the mines. The coal spoils and pyrolized gob piles that were deposited along drainages and on the floodplain continue to be a source of metal-laden acidic drainage. Aquatic life in the river, and more specifically the area feeder streams, has been adversely affected by depressed pHs and elevated concentrations of metals in the water and sediment columns of the BSF.

Following a three-year investigation to identify, characterize, and prioritize water quality impacts that result from CMD at the BISO, the NPS has selected nine *priority* sites for potential remediation (see *Figure 1-2*). These nine sites were selected based on expected improvements that remediation likely would have on water quality of the BSF. The NPS proposes to use passive treatment methods [i.e., lined channels, anoxic limestone drains (ALDs), and artificially-constructed wetlands] to remediate these sites. The selected sites and proposed remedial actions are described below.

1) **Laurel Branch Stream Spoils** – This site consists of a small stream (Laurel Branch) draining through pyrolized spoil piles. The creek exhibits characteristics of CMD, such as relatively low pH, high acidity, and high metal content. The NPS proposes to segregate the stream from the pyrolized spoil piles by installing a culvert and lining a portion of the stream channel. This would segregate the surface flow from the contaminated spoils.

AMEC Earth & Environmental, Inc.
2904 Westcorp Blvd., Suite 107
Huntsville, AL 35805
Telephone (256) 539-3016
Facsimile (256) 539-3074

2) **Laurel Branch Confluence** – This site consists of pyrolized spoil piles located along the floodplain of the BSF, near the Laurel Branch confluence. The NPS proposes to regrade the spoil area and construct an interceptor channel at the edge of the spoils to convey surface runoff away from the spoils.

3) **Devils Creek** – This creek is directly impacted by CMD from an abandoned mine adit. The NPS proposes to intercept the mine waters and construct an ALD and a wetland treatment system to treat the CMD. The treatment system would be built along the BSF floodplain.

4) **Blue Heron Spoils** – This area contains numerous pyrolized spoil piles along the BSF and in adjacent upslope areas. The NPS proposes to regrade selected areas and construct lined ditches to segregate surface waters from the mine spoils.

5) **Blair Creek** – Blair Creek is impacted by CMD from both mine spoils and directly from adits. The NPS proposes to segregate the CMD from the main stream and treat it using a constructed treatment system. The system would be located on the BSF floodplain near the Blair Creek confluence.

6) **Worley Mine #88** – CMD is draining from the mine adit at the Worley Mine #88 entrance. The NPS proposes to treat this CMD using an ALD and constructed wetland treatment system.

7) **Worley Mine #86** – Worley Branch is receiving CMD from the Mine #86 adit. The NPS proposes to construct an ALD and wetland treatment system within the Worley Branch drainage basin above the BSF floodplain.

8) **Slavey Hollow** – CMD is entering Slavey Hollow directly from a mine portal. The NPS proposes to construct a wetland treatment system on the BSF floodplain adjacent to Slavey Hollow. The CMD would be piped from the mine adit to the treatment system.

9) **Nancy Graves** – Nancy Graves Creek is impacted by CMD from spoil piles. The NPS proposes to use lined stream channels and a constructed wetland treatment system to treat the CMD. The constructed wetland would be located on the BSF floodplain.

Access to all sites for remediation and periodic maintenance purposes would be gained through pre-existing unmaintained and maintained roadways and trails within the BISO. Some grading and/or re-grading consistent with typical roadway maintenance activities will be necessary in order to ensure safe and adequate working conditions. All such activities will follow standard NPS procedures and guidelines.

As the first phase of this EA, AMEC will identify environmental resources, issues, and constraints associated with the project area, in order to more effectively assess the environmental impacts associated with the proposed remedial actions. Therefore, AMEC is requesting baseline information on any concerns that your organization may have related to potential environmental issues in the project area or vicinity of this section of the BSF. Information you can provide on *any* of the following environmental issue areas (at or in the vicinity of the site) would be appreciated:

- Surface and groundwater resources, including streams, wetlands, floodplains, open water features, and local aquifers;

- Soils data, including list of hydric soils (NRCS);

- Federally or state listed threatened or endangered species, or any species proposed for such listing, or critical habitat for such species;

- Parks, nature preserves, conservation areas, designated wild or scenic rivers, migratory bird habitats, special wildlife issues, and other natural resource issues of concern;

- Known cultural resource (historic or prehistoric) sites or issues; and

- Any additional environmental, cultural, or socioeconomic information or concern your agency may have with regard to the referenced project.

AMEC has requested information from a number of organizations (see attached list). If you are aware of other individuals or resource agencies who may possess additional information or knowledge that may assist us in preparing the EA for the NPS, please either contact us or forward this letter for their review, and include any returned comments with your response.

We, in cooperation with the NPS and the BISO, look forward to your participation in this NEPA review process. Your response on or before May 3, 2001 will enable us to complete this phase of the project within the scheduled timeframe. If you have any questions concerning this request, please do not hesitate to contact me at (256) 539-3016 or Mary Motte Walker at (615) 333-0630.

Sincerely,

Jonathon G McMillen

Jonathon G. McMillen
Project Manager
AMEC Earth & Environmental, Inc.

Attachments: Agency contact list
Figure 1-1, Location Map
Figure 1-2, Project Sites Reference Map

AGENCY CONTACT LIST

United States Fish and Wildlife Service
Cookeville Field Office
446 Neal Street
Cookeville, TN 38501
Attn: Dr. Lee Barclay, Field Supervisor
Phone: (931) 528-6481

Natural Resources Conservation Service
771 Corporate Drive, Suite 110
Lexington, KY 40503-4579
Attn: Mr. David Sawyer, State Conservationist
Phone: (859) 224-7350

U.S. Environmental Protection Agency
Region 4, Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, GA 30303-3104
Attn: Mr. John Hankinson, Regional Administrator
Phone: (404) 562-8357
Fax: (404) 562-8174

Kentucky Department of Fish and Wildlife Resources
#1 Game Farm Road
Frankfort, KY 40601
Attn: Mr. Wayne Davis, Environmental Section Director
Phone: (502) 564-5448

Kentucky State Nature Preserves Commission
801 Schenkel Lane
Frankfort, KY 40601-1403
Attn: Mr. Don Dott, Director
Phone: (502) 573-2886
Fax: (502) 573-2355

The Nature Conservancy, Kentucky Chapter
642 West Main Street
Lexington, KY 40508-2018
Attn: Mr. Jim Aldrich, Director
Phone: (859) 259-9655
Fax: (859) 259-9678

Kentucky Department of Environmental Protection
14 Reilly Road
Frankfort, KY 40601
Attn: Mr. Jack Wilson, Director of Division of Water
Phone: (502) 564-2150
Fax: (502) 564-4245

Kentucky Heritage Council
300 Washington Street
Frankfort, KY 40601
Attn: Mr. David Morgan, Director
Phone: (502) 564-7005
Fax: (502) 564-5820

Kentucky Historical Society
100 West Broadway
Frankfort, KY 40601
Attn: Mr. Kevin Graffagnino
Phone: (502) 564-1792

Kentucky Department of Surface Mining Reclamation and Enforcement
Division of Field Services
#2 Hudson Hollow Rd.
Frankfort, KY 40601
Attn: Mr. Mark Thompson, Director
Phone: (502) 564-6940
Fax: (502) 564-5698

Kentucky Geological Survey
228 Mining and Mineral Resources Building
University of Kentucky
Lexington, KY 40506-0107
Attn: Dr. Jim Drahovzal
Phone: (859) 257-5500
Fax: (859) 257-1147

Kentucky Department for Natural Resources
Division of Conservation
663 Teton Trail
Frankfort, KY 40601
Attn: Mr. Stephen Coleman, Director
Phone: (502) 564-3080
Fax: (502) 564-9195

Kentucky Department for Natural Resources
Division of Forestry
627 Comanche Trail
Frankfort, KY 40601
Attn: Mr. Mark Matuszewski, Director
Phone: (502) 564-4496
Fax: (502) 564-6553

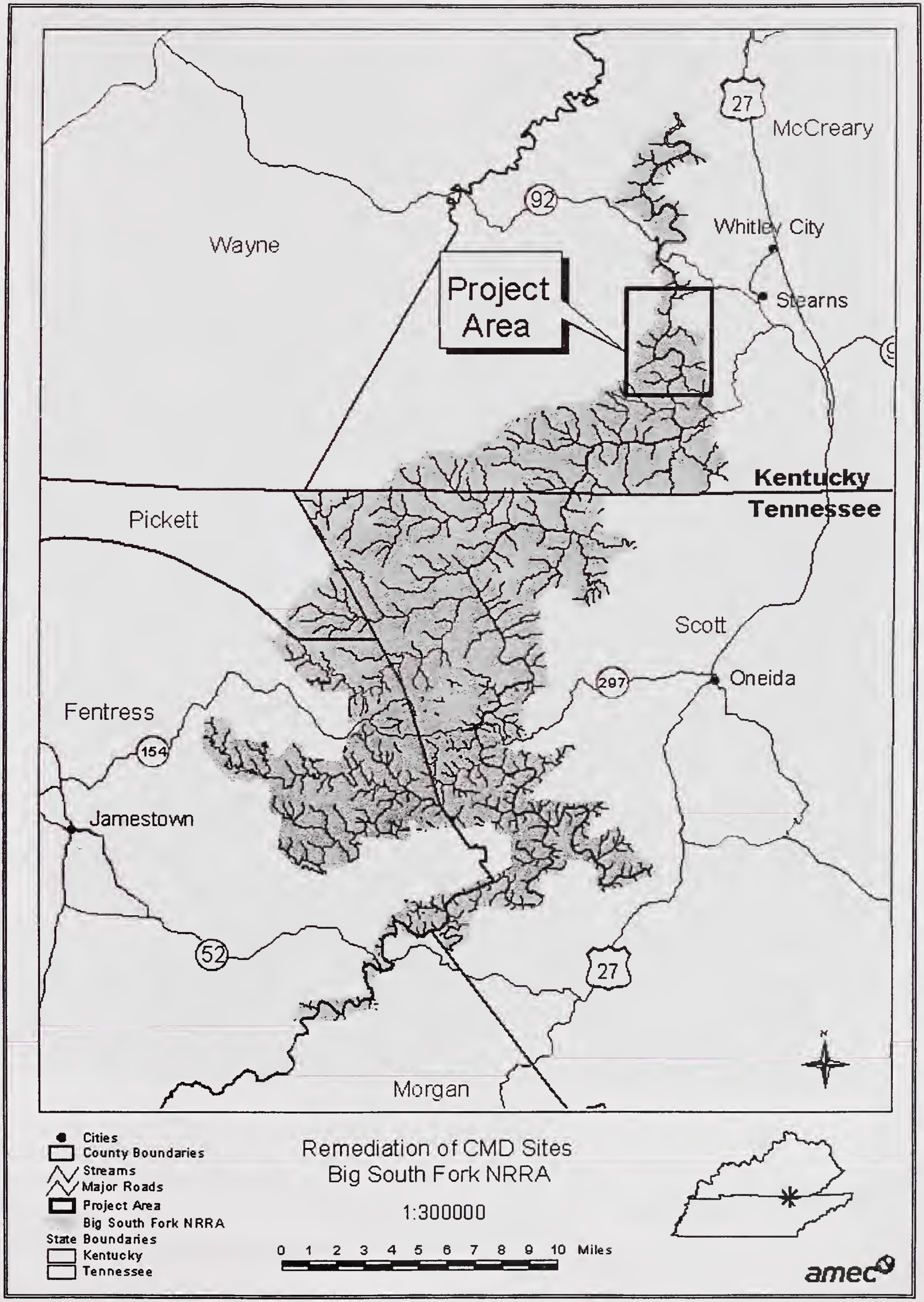

Figure 1-1 Location of the Big South Fork NRRA and Project Area

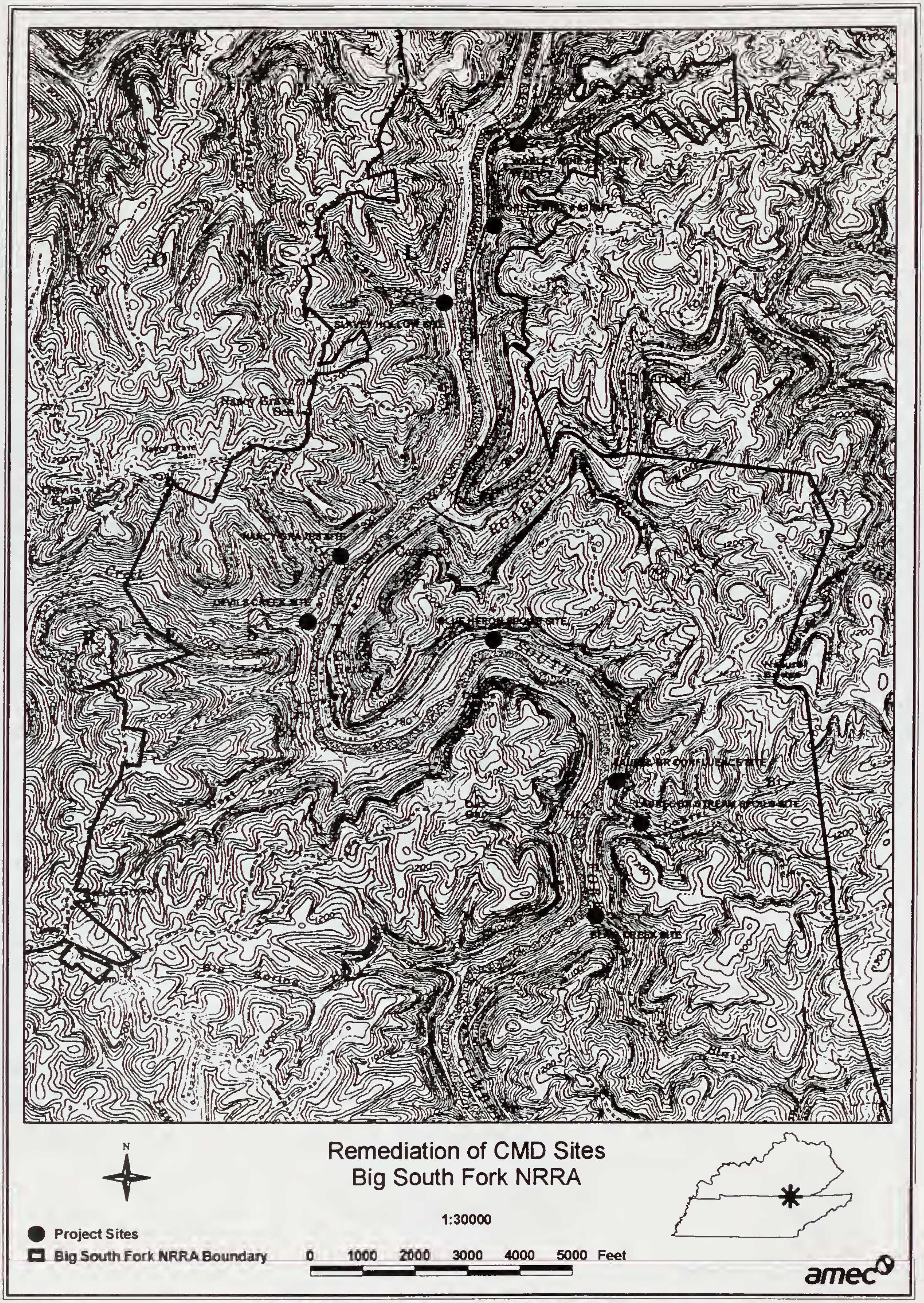

Figure 1-2 Topographic Reference Map for Project Area

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

April 25, 2001

Mr. Jonathon G. McMillen
AMEC Earth & Environmental, Inc.
2904 Westcorp Blvd., Suite 107
Huntsville, Alabama 35805

Subject: Scoping for an Environmental Assessment (EA) for Remediation of Selected Contaminated Mine Drainages at the Big South Fork National River and Recreation Area, McCreary County, Kentucky.

Dear Mr. McMillen:

Fish and Wildlife Service personnel have reviewed the description of the subject project proposal that you included with your letter dated April 5, 2001. Please consider the following comments during development of the EA.

The project has the potential to negatively affect the following species:

duskytail darter (*Etheostoma percnurum*) - endangered
Cumberland elktoe (*Alasmidonta atropurpurea*) - endangered
Cumberlandian combshell (*Epioblasma brevidens*) - endangered
Cumberland bean pearlymussel (*Villosa trabalis*) - endangered
oyster mussel (*Epioblasma capsaeformis*) - endangered
tan riffleshell (*Epioblasma walkeri*) - endangered
little-wing pearlymussel (*Pegias fabula*) - endangered
Cumberland rosemary (*Conradina verticillata*) - threatened
Cumberland sandwort (*Minuartia cumberlandensis*) - endangered
Indiana bat (*Myotis sodalis*) - endangered

The EA should address the potential for impacts to these species and measures that would be proposed for avoidance of those impacts. We will gladly coordinate with you or representatives of the National Park Service regarding the need for specific measures for protection of these species.

Thank you for this opportunity to provide input for the proposed remediation effort. Please contact David Pelren of my staff at 931/528-6481 (ext. 204) or by e-mail at *david_pelren@fws.gov* if you have questions about these comments.

Sincerely,

Lee A Barclay

Lee A. Barclay, Ph.D.
Field Supervisor.

FISH & WILDLIFE COMMISSION
Mike Boatwright, Paducah
Tom Baker, Bowling Green, Chairman
Allen K. Gailor, Louisville
Charles E. Bale, Hodgenville
Dr. James R. Rich, Taylor Mill
Ben Frank Brown, Richmond
Doug Hensley, Hazard
Dr. Robert C. Webb, Grayson
David H.Godby, Somerset

KENTUCKY DEPT. OF FISH & WILDLIFE RESOURCES

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF FISH AND WILDLIFE RESOURCES
C. THOMAS BENNETT, COMMISSIONER

April 24, 2001

Jonathan G. McMillen
Project Manager
AMEC Earth & Environmental, Inc.
2904 Westcorp Blvd., Suite 107
Huntsville, AL 35805

Re: Threatened/endangered species review: Consultation for the Environmental Assessment for Remediation of Selected Contaminated Mine Drainages at the Big South Fork National River and Recreation Area, McCreary County, Kentucky

Dear Mr. McMillen:

The Kentucky Department of Fish and Wildlife Resources (KDFWR) has received your request for the above-referenced information. The Kentucky Fish and Wildlife Information System indicates that the federally endangered Indiana bats are known to occur in the Barthell 7.5 minute USGS quadrangle. Please be aware that our database system is a dynamic one that only represents our current knowledge of the various species distributions.

In quadrangles in which Indiana bats are known to occur, any wooded areas that may be impacted by the proposed project should be examined for potential Indiana bat habitat. Indiana bats form maternity colonies and roost under the bark of trees in both riparian and upland areas. Therefore, disturbance of trees with exfoliating bark, dead limbs or cavities should be avoided between March 31 and October 15.

KDFWR has determined that potential negative impacts to the aquatic resources can occur in the project area and offers the following recommendations:

1) proper placement of erosion control structures below disturbed areas to minimize entry of silt to stream;
2) replanting of disturbed areas after construction, including stream banks and right-of-ways, with native vegetation for soil stabilization and enhancement of fish and wildlife populations;
3) avoidance of tree canopy overhanging streams; and
4) return all right-of-ways to original elevation.

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As the project will improve environmental conditions in the immediate area, we do not anticipate any significant impacts to fish and wildlife resources from this project.

Should you require additional information or have any questions, please feel free to contact the Environmental Section at 502-564-7109, ext. 367.

Sincerely,

Marla J Barbour

Marla Barbour
Fisheries Biologist III

Cc: Environmental Section Files

Federally Listed T&E Species Reported from BARTHELL Quadrangle

Common Name	Scientific Name	Status Code	Reference
Indiana myotis	Myotis sodalis Miller and Allen, 1928	223, 101, 108, 601	Reference

This list was created through the Kentucky Fish and Wildlife Information System.

Education, Arts and Humanities Cabinet

KENTUCKY HERITAGE COUNCIL
The State Historic Preservation Office

Paul E. Patton
Governor
Marlene M. Helm
Cabinet Secretary

David L. Morgan
Executive Director and
SHPO

May 14, 2001

Mr. Jonathan G. McMillen
Project Manager
AMEC Earth & Environmental, Inc.
2904 Westcorp Blvd., Suite 107
Huntsville, Alabama 35805

Re: Environmental Assessment for Remediation of Selected Contaminated Mine Drainages at the Big South Fort National River and Recreation Area, McCreary County, Kentucky.

Dear Mr. McMillen:

Thank you for your letter concerning the above referenced project. Our review indicates that the proposed project has the potential to impact properties eligible for listing in the National Register of Historic Places. In particular, the Worley Mine contains extant features from the mine and community that was associated with the mine. This includes the old railroad, foundations of buildings, a tipple, and stairways. These and other resources associated with this mine should be fully documented and potential effects to these features from the proposed undertaking identified and evaluated. Several other projects mention treatment systems that will be constructed in the Big South Fork floodplain. If these systems are to be placed in areas that have not been previously disturbed by mining they should be surveyed by a professional archaeologist. A report documenting any archaeological surveys undertaken as part of this project should be submitted to this office for review, comment, and approval.

If you have any questions concerning this project please feel free to contact David Pollack of my staff at 502-564-7005.

Sincerely,

David L. Morgan, Director
Kentucky Heritage Council and
State Historic Preservation Officer

300 Washington Street
Frankfort, Kentucky 40601
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Secretary

Paul E. Patton
Governor

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR SURFACE MINING RECLAMATION & ENFORCEMENT
FRANKFORT, KENTUCKY 40601
CARL E. CAMPBELL
COMMISSIONER

April 26, 2001

Mr. Jonathon G. McMillen, Project Manager
AMEC Earth & Environmental, Inc.
2904 Westcorp Blvd., Suite 107
Huntsville, AL 35805

Subject: Environmental Assessment for Remediation of Mine Drainages at the Big South Fork National River and Recreation Area, McCreary County, Kentucky

Dear Mr. McMillen:

This correspondence is in reference to your request for information pertaining to surface and groundwater resources, soils data, and land use.

As you are aware, our agency regulates coal-mining activities. Our regulations require that applications for a permit to mine coal include data for baseline stream water quality, ground water monitoring, and baseline geologic data. An assessment of the current land use and soils are also included in these applications. Some of this data may be helpful in your preparation of the environmental assessment. Therefore, I have asked a member of my staff to prepare a resource list for you.

The resource list includes internet links to our web page where you may access water quality data for permits located proximal to your area of interest. This data also includes NPDES point source discharge monitoring data for sediment control ponds and other discharge from permitted areas, and comprises a period from 1988 to the present.

Additionally, the resource list includes permit numbers for applications within or adjacent to the areas of interest indicated in your correspondence. If you find this information pertinent to your study area, information from the permit file can be provided to you.

I hope you find this information helpful. If you have questions or require additional information regarding these resources, please feel free to contact Pam Carew, or myself at (502) 564-2340.

Sincerely,

Mark Thompson

Mark Thompson, Director
Division of Field Services

Attachment

MWT/pbc/

Kentucky Department for Surface Mining Reclamation and Enforcement
Resource List for Big South Fork National River and Recreation Area
McCreary County, Kentucky

Internet Information: http://www.nr.state.ky.us/nrepc/ois/gis/dsmre/dsmre.htm

This link will provide access to our Home Page, where you may search our GIS data base for permit application numbers based on location. Water quality data is also available via the GIS.

GIS Search: Our search of the areas of interest indicate that the following permit applications exist which may contain data pertaining to stream water quality, groundwater quality, geologic data regarding the nature of acid or alkaline-producing strata, soils, and land use:

Barthell Topographic Quadrangle:

DSMRE Permit #	Permittee	Type operation	Latitude	Longitude
874-5011	Southfork Coal	Underground	364054	842930
(located on Coffey Branch – underground works extend under Cooper Branch north of Roaring Paunch Branch)				

Whitley City Quadrangle:

DSMRE Permit #	Permittee	Type operation	Latitude	Longitude
874-5005	Southfork Coal	Underground	364046	842818
(located on Sweet Gum Branch)				
874-8004	Southfork Coal	Preparation Plant	364018	842727

James E. Bickford
Secretary

Paul E. Patton
Governor

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR NATURAL RESOURCES
DIVISION OF CONSERVATION
663 TETON TRAIL
FRANKFORT, KENTUCKY 40601

May 3, 2001

Jonathan G. McMillen
AMEC Earth and Environmental, Inc.
2904 Westcorp Blvd., Suite 107
Huntsville, AL 35805

RE: Environmental Assessment for Contaminated Mine Sites in the Big South Fork National River and Recreation Area (BISO)

Per your request, the Kentucky Division of Conservation has reviewed the project referenced above in order to provide soils data and express any concerns we may have related to potential environmental issues.

Enclosed is a copy of the McCreary County-Whitely Area Soil Survey that contains detailed soil maps and soil information. This should help with baseline soil data. Also enclosed are copies of soil maps 49, 50, 58, and 59 put together to indicate the approximate location of each site to make it easier to find these sites on the published soil survey maps.

In addition to the soil survey, there is a hydric soils list for McCreary County enclosed. No hydric soils or soils containing hydric inclusions were mapped at the priority sites. However, there is a possibility hydric soils could be present. An on-site inspection would be the best way to confirm this possibility.

The major concern we would like to comment on is that of controlling erosion and sedimentation during and after earth-disturbing activities once this project begins. We strongly recommend best management practices (BMPs) be utilized to prevent nonpoint source water pollution. Information on BMPs appropriate for this project can be found in the manuals, *Best Management Practices for Surface Coal Mining*, available through the Kentucky Department of Surface Mining Reclamation, and *Best Management Practices for Construction Activities*, available through the McCreary County Conservation District or this office.

We appreciate the opportunity to comment on this project. If you have any questions, please contact this office any time.

Sincerely,

Mark Davis

Mark Davis, Environmental Control Specialist
KY Division of Conservation

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HYDRIC SOILS

McCREARY COUNTY

KENTUCKY

Hydric Soil Map Units (Where not drained and/or not protected from flooding)

Symbol	Name	Hydric part if not whole map unit
At	Atkins silt loam 1/	
Re	Robertsville silt loam 1/	

1/ Hydric due to saturation
2/ Hydric due to seasonal flooding (None Identified)
3/ Hydric due to seasonal ponding (None Identified)

Map Units That May Have Inclusions of Hydric Soils

Symbol	Name	Probable landscape position of Hydric Inclusions
Ct	Cotaco silt loam	Atkins soils in low spots
Ek	Elk silt loam	Atkins soils in low spots
Pf	Philo fine sandy loam	Atkins soils in low spots
Sd	Stendal sandy loam	Atkins soils in low spots
Ty	Tyler silt loam	Robertsville soils in low spots

All hydric soils in this county support or would have supported woody vegetation under natural conditions except those identified as swamp or ponded phases.

SOIL SURVEY

McCreary-Whitley Area, Kentucky

OUR SOIL ★ OUR STRENGTH

Issued June 1970

UNITED STATES DEPARTMENT OF AGRICULTURE
Forest Service and Soil Conservation Service
In cooperation with
KENTUCKY AGRICULTURAL EXPERIMENT STATION

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR NATURAL RESOURCES
DIVISION OF FORESTRY
MARK MATUSZEWSKI, DIRECTOR
627 COMANCHE TRAIL
FRANKFORT, KENTUCKY 40601

April 16, 2001

Jonathon G. McMillen, Project Manager
AMEC Earth & Environmental, Inc.
2904 Westcorp Boulevard, Suite 107
Huntsville, AL 35805

Dear Mr. McMillen:

The Kentucky Division of Forestry staff as well as our local district office has reviewed your letter of April 5, 2001, regarding proposed remediation efforts relative to pollution caused by past mining in McCreary County. This is to advise you that the Division of Forestry does not have any information of the type you request which would contribute to your environmental assessment.

If you have any further questions, please contact Cary Perkins, Forest Stewardship Section Supervisor, at 502-564-4496. We look forward to being able to meet with you and await your reply.

Sincerely,

Leah W. MacSwords
Acting Director

LWM:WCP:rb

c Diana Olszowy
  Cary Perkins

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APPENDIX D
Water Quality Data Collected from May 1996 through April 1997

All data in this appendix from a previously-published report (*Gannett Fleming, Inc., 1998)*

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Table 9. Water Quality Data Collected From the Mouth of Devils Creek at Sample Location Number 21 (SSPIIDC01).

Date Sampled	05/09/96	06/13/96	07/17/96	08/21/96	09/23/96	10/17/96	11/19/96	02/18/97	3/21/97	04/17/97
pH - lab	7.04	6.77	3.38	3.42	3.08	3.11	6.71	6.45	6.14	5.65
pH - field	6.31	6.36	4.72	3.71	3.06	3.0	5.61	5.50	6.72	6.64
Acidity (mg/L CaCO3)	<10	< 10	48	48	110	140	N/A	N/A	ND	< 10
Temperature (deg C)	14.3	16.9	20.4	21.0	16.4	13.5	8.9	6.9	8.9	9.8
Conductivity (umhos/cm)	44	69	657	616	1119	1191	83	51	35	91
Dissolved Oxygen (mg/L)	9.8	11	11.0	13.0	8.6	8.1	11.2	11.3	ND	10.4
Redox Potential (mVolts)	-8.0	-24.4	-33.4	280.6	291.6	288.6	-50.4	269.4	321.4	407.4
Alkalinity (mg/L CaCO3)	<20	< 20	-	-	-	^-	24	< 20	<20	< 20
Measured TDS at 180 deg C	32	41	370	350	640	530	24	N/A	ND	N/A
Discharge Rate (cfs)	7.290	6.190	0.758	0.157	0.135	0.136	3.753	9.382	28.000	2.278
	(mg/L)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	<0.026	0.066	1.3	1.1	2.9	3.2	^<0.024	0.12	< 0.024	< 0.024
Total Aluminum (Al+3)	0.28	0.46	1.5	1.2	2.7	3	0.61	0.32	0.29	0.4
Arsenic (As+3)	<0.0066	< 0.0066	< 0.0066	< 0.0066	^<0.0066	^<0.0066	^<0.0066	<0.0066	< 0.0066	< 0.0066
Cadmium (Cd+2)	<0.001	< 0.001	< 0.0010	< 0.0010	< 0.0010	^<0.0010	^<0.0010	<0.00085	<0.00085	< 0.00085
Calcium (Ca+2)	3.7	6.3	37	39	62	68	6.8	3.7	2.8	8.4
Chromium (Cr+3)	<0.001	< 0.001	< 0.0036 B	< 0.0010	^<0.0010	0.0037	^<0.0010	<0.0042	<0.0042	< 0.0042
Copper (Cu+2)	0.0076	< 0.0029	0.01	0.0077	^<0.018	0.0066	0.019	0.012	0.021	< 0.0025
Iron (Fe)	0.05	0.11	2.4	3.3	13	16	0.37	0.075	<0.022	0.036
Total Iron (Fe)	0.25	0.38	2.8	4.4	14	18	3.1	0.21	0.28	0.33
Lead (Pb+2)	<0.0011	0.013	< 0.0011	<0.0011	< 0.0011	< 0.0011	^<0.0011	0.0028	< 0.0011	< 0.0011
Magnesium (Mg+2)	1.6	2.2	18	16	28	28	2.4	1.7	1.2	3.1
Manganese (Mn+2)	0.1	0.26	6.4	6	11	12	0.4	0.14	0.034	0.51
Total Manganese (Mn+2)	0.11	0.25	6	6.2	11	12	0.44	0.14	0.035	0.47
Selenium (Se+4)	<0.0033	< 0.0033	< 0.0033	< 0.0033	^<0.0033	^<0.0033	^<0.0033	< 0.0066	<0.0066	< 0.0066
Sodium (Na+)	1	1.6	22.0	20	40	39	2.2	1.3	0.73	2.4
Zinc (Zn+2)	0.006	0.0066	0.05	0.055	0.072	0.084	< 0.0016	0.024	0.012	0.013
Chloride (Cl-)	<10	< 10	< 10	<10	^<10	^< 10	^<10	< 10	12	10
Sulfate (SO4-2)	13	19	240	230	400	470	25	11	<11	29
Fe+2 field spectroph.	0.00	0.02	0.83	0.37	1.35	1.58	0.29	NS	0.00	0.00
Fe+3 by difference	0.05	0.09	1.57	2.93	0.00	14.42	0.08	0.08	0.00	0.04

Table 11. Water Quality Data Collected From the Mouth of Laurel Branch Creek at Sample Location Number 41 (SSPIILB01).

Date Sampled	05/07/96	06/11/96	07/16/96	08/20/96	09/18/96	10/16/96	11/19/96	02/18/97	3/20/97	04/16/97
pH - lab	5.39	5.23	3.38	3.48	3.42	3.44	5.17	5.00	5.15	4.51
pH - field	5.25	5.6	3.97	3.30	3.50	3.69	4.72	5.00	5.86	4.69
Acidity (mg/L CaCO3)	<10	< 10	40	72	78	78	<10	< 10	<10	14
Temperature (deg C)	13.4	14.5	19.4	21.2	15.5	12.9	10.1	9.7	8.9	5.9
Conductivity (umhos/cm)	40	46	387	442	475	492	60	44	35	98
Dissolved Oxygen (mg/L)	10.1	10.8	12.2	10.2	9.2	8.9	11.0	10.5	10.9	11.5
Redox Potential (mVolts)	37.1	-81.4	-33.4	137.6	210.6	187.6	51.6	534.4	328.4	954.4
Alkalinity (mg/L CaCO3)	<20	< 20	-	-	-	^-	20	< 20	<20	< 20
Measured TDS at 180 deg C	29	29	190	230	230	220	56	N/A	ND	N/A
Discharge Rate (cfs)	6.260	4.420	0.354	0.030	0.090	0.058	6.355	3.903	26.075	2.610
	(mg/L)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	0.08	0.13	4.6	5.3	5.4	5.6	0.21	0.41	0.12	0.92
Total Aluminum (Al+3)	0.72	0.53	4.1	5.3	5.4	5.8	0.51	0.56	0.47	1
Arsenic (As+3)	<0.0066	< 0.0066	< 0.0066	< 0.0066	^<0.0066	^<0.0066	^< 0.0066	< 0.0066	<0.0066	< 0.0066
Cadmium (Cd+2)	<0.001	< 0.001	< 0.0010	< 0.0010	< 0.0010	^<0.0010	^<0.0010	<0.00085	<0.00085	< 0.00085
Calcium (Ca+2)	2.1	3.4	16	18	16	18	3.8	3.8	2.1	5.8
Chromium (Cr+3)	<0.001	< 0.001	< 0.0036 B	< 0.0010	^<0.0010	^<0.0010	^< 0.0010	<0.0042	<0.0042	< 0.0042
Copper (Cu+2)	0.0074	< 0.0043	0.0083	0.0073	< 0.0029	0.018	^<0.0025	0.012	<0.012	0.019
Iron (Fe)	0.17	0.85	7.3	6.8	7.3	7.2	0.42	1.2	0.15	2.5
Total Iron (Fe)	0.57	1.1	7.4	4.8	7.3	7.8	0.67	1.2	0.36	2.6
Lead (Pb+2)	<0.0011	< 0.0011	< 0.0011	< 0.0011	^<0.0011	< 0.0011	^<0.0011	<0.0011	<0.0011	< 0.0011
Magnesium (Mg+2)	1.2	1.6	7.1	8.7	8.4	8.9	1.6	1.6	1.1	2.6
Manganese (Mn+2)	0.05	0.095	1	1.4	1.3	1.4	0.11	0.13	0.036	0.23
Total Manganese (Mn+2)	0.066	0.1	1.1	1.4	1.2	1.4	0.13	0.12	0.044	0.24
Selenium (Se+4)	<0.0033	< 0.0033	< 0.0033	< 0.0033	^<0.0033	^<0.0033	^<0.0033	<0.0066	< 0.0066	< 0.0066
Sodium (Na+)	1.1	1.4	2.3	2.8	3.1	3.1	1.4	1.4	0.72	1.3
Zinc (Zn+2)	0.0056	0.0051	0.08	0.073	0.06	0.062	0.0068	0.0082	0.01	0.025
Chloride (Cl-)	<10	< 10	< 10	<10	^<10	^<10	^<10	< 10	<10	<10
Sulfate (SO4-2)	12	22	120	130	140	160	19	11	<11	33
Fe+2 field spectroph.	0.1	0.54	2.43	3.21	4.58	4.18	0.4	0.87	0.09	1.6
Fe+3 by difference	0.07	0.31	4.87	3.59	2.72	3.02	0.02	0.33	0.06	0.9

Table 13. Water Quality Data For the Discharge Emanating From the Blue Heron Spoil-Pine Plantings at Sample Location Number 36 (SSPIIBH01).

Date Sampled	**05/08/96**	**06/11/96**	**11/19/96**
pH - lab	2.70	2.48	2.40
pH - field	2.78	ND	2.36
Acidity (mg/L CaCO3)	360	620	860
Temperature (deg C)	10.5	15.7	13.1
Conductivity (umhos/cm)	1400	1956	3430
Dissolved Oxygen (mg/L)	10.3	8.1	7.3
Redox Potential (mVolts)	276.0	307.6	319.6
Alkalinity (mg/L CaCO3)	N/A	-	N/A
Measured TDS at 180 deg C	760	1800	2000
Discharge Rate (cfs)	0.04	0.035	0.04
	(mg/L)	**(mg/l)**	**(mg/l)**
Aluminum (Al+3)	19	39	58
Total Aluminum (Al+3)	19	41	53
Arsenic (As+3)	<0.0066		^< 0.0066
Cadmium (Cd+2)	<0.001		< 0.0010
Calcium (Ca+2)	66	120	180
Chromium (Cr+3)	0.0086	0.019	0.02
Copper (Cu+2)	0.036	0.036	0.052
Iron (Fe)	43	74	92
Total Iron (Fe)	43	78	100
Lead (Pb+2)	<0.0011		^<0.0011
Magnesium (Mg+2)	22	42	61
Manganese (Mn+2)	2.9	5.1	6.8
Total Manganese (Mn+2)	3	5.1	6.8
Selenium (Se+4)	<0.0033	< 0.0033	^<0.0066
Sodium (Na+)	4.6	6.2	8.9
Zinc (Zn+2)	0.12	0.21	0.28
Chloride (Cl-)	<10	< 10	50
Sulfate (SO4-2)	680	1200	1600
Fe+2 field spectroph.	2.8	2.24	0.4
Fe+3 by difference	40.2	71.76	91.6

Table 14. Water Quality Data For the Discharge Emanating From the Blue Heron Spoil-South(N) at Sample Location Number 35i (SSPIIBH02N).

Date Sampled	02/18/97	04/16/97	07/16/96	08/20/96	10/16/96	3/20/97	09/23/96
pH - lab	3.03	2.89	2.53	2.62	2.45	2.88	2.39
pH - field	4.00	2.63	2.40	1.77	2.70	3.31	2.67
Acidity (mg/L CaCO3)	280	410	900	740	1500	350	1100
Temperature (deg C)	15.5	19.6	22.5	32.0	24.0	22.3	16.6
Conductivity (umhos/cm)	NS	1715	2480	2100	3950	1453	3420
Dissolved Oxygen (mg/L)	1.9	5.9	3.2	5.0	3.2	6.7	3.9
Redox Potential (mVolts)	659.4	739.4	155.6	250.6	227.6	307.4	200.6
Alkalinity (mg/L CaCO3)	N/A	N/A	-	-	^-	ND	-
Measured TDS at 180 deg C	770	1000	1400	2200	2600	920	2100
Discharge Rate (cfs)							
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	8.6	9.5	25.00	23	68	6.1	47
Total Aluminum (Al+3)	10	9.8	62.00	49	58	7.3	50
Arsenic (As+3)	< 0.0066	< 0.0066	< 0.0066	< 0.0066	^<0.0066	< 0.0066	^<0.0066
Cadmium (Cd+2)	<0.00085	< 0.00085	< 0.0010	< 0.0010	0.0028	<0.00085	0.021
Calcium (Ca+2)	62	130	110	200	130	86	94
Chromium (Cr+3)	0.0091	0.0085	0.02	0.022	0.057	<0.0042	0.017
Copper (Cu+2)	0.012	0.021	0.06	0.038	0.15	0.027	0.14
Iron (Fe)	65	46	120.00	130	340	18	300
Total Iron (Fe)	75	47	210.00	170	380	18	330
Lead (Pb+2)	<0.0011	0.0028	0.01	0.0091	^<0.0011	0.014	0.0073
Magnesium (Mg+2)	24	37	39.0	62	46	29	43
Manganese (Mn+2)	1.3	2.3	3.60	6.2	16	1.2	6
Total Manganese (Mn+2)	1.3	2.1	3.90	6.2	13	1.2	4.1
Selenium (Se+4)	<0.0066	< 0.0066	<0.0033	< 0.0066	^<0.0033	< 0.0066	^<0.0033
Sodium (Na+)	4.9	5	8.2	6.9	5.8	3.2	7.4
Zinc (Zn+2)	0.06	0.071	0.13	0.19	0.31	0.053	0.35
Chloride (Cl-)	< 50	< 10	< 25	<50	140	<10	^<100
Sulfate (SO4-2)	600	760	2000	1500	2100	580	1800
Fe+2 field spectroph.	38.00	2.05	70.50	60.00	67.00	1.30	78.00
Fe+3 by difference	27.00	43.95	49.50	70.00	273.00	16.70	222.00

Table 15. Water Quality Data For the Discharge Emanating From the Blue Heron Spoil-South at Sample Location Number 35 (SSPIIBH02).

Date Sampled	05/08/96	06/11/96	07/16/96	3/20/97	04/16/97
pH - lab	2.84	2.22	2.24	2.49	2.99
pH - field	2.88	ND	2.17	3.08	2.80
Acidity (mg/L CaCO3)	500	2400	5000	1200	340
Temperature (deg C)	14.9	21	21.8	15.0	21.1
Conductivity (umhos/cm)	1190	8480 (?)	7850	2520	1386
Dissolved Oxygen (mg/L)	2.9	1.5	4.0	1.1	7.4
Redox Potential (mVolts)	190.0	110.6	133.6	301.4	714.4
Alkalinity (mg/L CaCO3)	N/A	-	-	ND	N/A
Measured TDS at 180 deg C	1000	12000	9400	1700	650
Discharge Rate (cfs)					
	(mg/L)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	15	480	380	25	9.5
Total Aluminum (Al+3)	49	480	430	23	8.1
Arsenic (As+3)	<0.0066	0.19	0.26	0.016	< 0.0066
Cadmium (Cd+2)	<0.001	0.0073	< 0.010	<0.00085	< 0.00085
Calcium (Ca+2)	78	340	400	95	58
Chromium (Cr+3)	0.014	0.42	0.36	0.023	0.0046
Copper (Cu+2)	0.039	0.49	0.30	0.072	0.017
Iron (Fe)	110	1700	1400	150	53
Total Iron (Fe)	170	1700	1600	150	52
Lead (Pb+2)	<0.0011	0.013	0.03	< 0.0011	< 0.0011
Magnesium (Mg+2)	24	97	110	18	22
Manganese (Mn+2)	1.5	11	12	1.6	1.6
Total Manganese (Mn+2)	1.6	12	12	1.5	1.5
Selenium (Se+4)	<0.0033	< 0.033	< 0.0066	<0.0066	< 0.0066
Sodium (Na+)	4.8	15	17	2.4	6
Zinc (Zn+2)	0.071	0.76	1.1	0.1	0.066
Chloride (Cl-)	<10	60	70	<100	< 50
Sulfate (SO4-2)	710	9600	7800	1600	540
Fe+2 field spectroph.	25.5	245	292	82	13.2
Fe+3 by difference	84.5	1455	1108	68	39.8

Table 16. Water Quality Data For the Discharge Emanating From the Blue Heron Spoil-North at Sample Location Number 34 (SSPIIBH04).

Date Sampled	05/08/96	06/11/96	07/16/96	08/20/96	09/23/96	10/16/96	11/19/96	02/18/97	3/20/97	04/16/97
pH - lab	2.74	2.58	2.62	2.59	2.59	2.57	2.34	2.77	2.98	2.72
pH - field	2.44	N/D	N/A	1.71	2.79	2.62	2.4	2.50	3.43	2.52
Acidity (mg/L CaCO3)	1300	490	600	3200	780	860	1600	500	350	1200
Temperature (deg C)	12.8	25	27.7	29.5	20.2	22.2	13.7	13.2	17.5	19.3
Conductivity (umhos/cm)	3375	2100	2490	4470	2470	2770	3990	NS	1268	2230
Dissolved Oxygen (mg/L)	0.4	3.5	5.2	0.8	3.7	3.7	4.7	6.9	6.6	7.3
Redox Potential (mVolts)	164.0	212.6	243.6	226.6	213.6	222.6	261.6	734.4	774.4	669.4
Alkalinity (mg/L CaCO3)	N/A	-	-	-	-	^-	N/A	N/A	ND	N/A
Measured TDS at 180 deg C	2000	1300	290	5900	2200	1900	3100	1400	650	1200
Discharge Rate (cfs)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	(mg/L)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	74	12	14	200	46	24	48	17	9.5	43
Total Aluminum (Al+3)	75	76	29	240	96	58	56	37	7.8	39
Arsenic (As+3)	0.048	< 0.0066	< 0.0066	0.19	^<0.0066	^<0.0066	0.021	< 0.0066	< 0.0066	0.039
Cadmium (Cd+2)	<0.001	< 0.001	< 0.0010	< 0.010	0.0087	< 0.0010	0.034	<0.00085	<0.00085	< 0.00085
Calcium (Ca+2)	54	160	170	130	200	190	200	150	64	40
Chromium (Cr+3)	0.083	0.0087	0.01	0.27	< 0.0010	0.021	0.032	0.011	<0.0042	0.048
Copper (Cu+2)	0.25	0.037	0.03	0.47	0.053	0.038	0.12	0.034	0.01	0.1
Iron (Fe)	340	68	84	970	130	160	360	62	7.1	210
Total Iron (Fe)	300	140	95	1100	180	190	420	76	8.1	210
Lead (Pb+2)	<0.0011	0.0036	0.01	0.0089	0.0093	0.0041	^<0.0011	0.0049	<0.0011	< 0.0011
Magnesium (Mg+2)	16	44	52	48	68	60	60	44	26	15
Manganese (Mn+2)	3.5	3.3	4	11	9.1	8.4	5.9	3.5	1.2	3.1
Total Manganese (Mn+2)	3.5	4	4	11	8.5	8.2	6.6	3.5	1.2	3.1
Selenium (Se+4)	<0.0033	< 0.0066	< 0.016	< 0.0066	^<0.0033	^<0.0033	^<0.0066	<0.0066	<0.0066	< 0.0066
Sodium (Na+)	1.7	4.8	5.5	7.1	7.5	7.4	5.7	4.6	2.7	2.7
Zinc (Zn+2)	0.26	0.11	0.13	0.89	0.28	0.25	0.24	0.14	0.082	0.2
Chloride (Cl-)	20	< 10	< 10	<100	^<10	55	^<150	< 100	10	< 250
Sulfate (SO4-2)	1900	1300	1100	4400	1600	1800	2700	1000	450	1100
Fe+2 field spectroph.	24.7	17.1	22.6	608	42	50	90	2.1	0.83	106
Fe+3 by difference	315.3	50.9	61.4	362	88	110	270	59.9	6.27	104

Table 23. Water Quality Data Collected From the Mouth of Three West Hollow at Sample Location Number 32 (SSPIITWH01).

Date Sampled	05/09/96	06/13/96	07/17/96	08/21/96	10/17/96	11/21/96	02/18/97	3/21/97	04/17/97
pH - lab	6.43	N/A	5.17	6.07	5.21	5.39	5.36	5.12	4.73
pH - field	5.51	6.18	5.38	5.62	5.09	5.84	5.50	5.34	5.96
Acidity (mg/L CaCO3)	<10	N/A	< 10	-	^<10	^<10	< 10	<10	< 10
Temperature (deg C)	14.1	16	16.7	17.5	14.6	9.0	7.5	9.8	9.0
Conductivity (umhos/cm)	41	49	138	147	193	68	49	31	76
Dissolved Oxygen (mg/L)	9.9	13.2	9.4	8.0	5.2	3.0	10.9	11.0	9.1
Redox Potential (mVolts)	-4.0	-13.4	-154.4	-36.4	-104.4	1.6	160.4	322.4	70.0
Alkalinity (mg/L CaCO3)	<20	NA	< 20	< 20	^<20	^<20	< 20	<20	< 20
Measured TDS at 180 deg C	36	21	82	86	150	65	N/A	14	N/A
Discharge Rate (cfs)	0.830	1.916	0.456	0.016	0.002	3.038	7.595	4.175	0.240
	(mg/L)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	0.029	0.05	0.07	< 0.026	0.066	0.076	0.12	0.049	0.076
Total Aluminum (Al+3)	0.42	0.21	0.05	0.2	0.39	0.31	0.12	0.19	0.079
Arsenic (As+3)	<0.0066	< 0.0066	< 0.0066	< 0.0066	^<0.0066	^<0.0066	< 0.0066	< 0.0066	< 0.0066
Cadmium (Cd+2)	<0.001	< 0.001	< 0.0010	< 0.0010	< 0.0010	^<0.0010	<0.00085	<0.00085	< 0.00085
Calcium (Ca+2)	2	2.9	6	8.1	8.1	4.2	2.1	1.6	5.2
Chromium (Cr+3)	<0.001	< 0.001	< 0.0036 B	< 0.0010	< 0.0010	^<0.0010	<0.0042	<0.0042	< 0.0042
Copper (Cu+2)	0.024	< 0.0029	0.01	<0.0029	< 0.0029	^<0.0025	0.012	<0.012	< 0.0025
Iron (Fe)	<0.0052	0.0091	< 0.026	0.023	^< 0.0052	^<0.0043	0.022	0.025	< 0.022
Total Iron (Fe)	0.31	0.2	< 0.026	0.14	0.28	0.1	0.05	0.15	< 0.022
Lead (Pb+2)	<0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	^<0.0011	<0.0011	<0.0011	< 0.0011
Magnesium (Mg+2)	1.4	1.9	4.3	5.2	5.5	2.6	1.4	1.3	3.4
Manganese (Mn+2)	0.03	0.046	0.05	0.025	0.042	0.067	0.038	0.03	0.037
Total Manganese (Mn+2)	0.036	0.047	0.05	0.03	0.048	0.067	0.037	0.025	0.026
Selenium (Se+4)	<0.0033	< 0.0033	< 0.0033	< 0.0033	^<0.0033	^<0.0033	< 0.0066	<0.0066	< 0.0066
Sodium (Na+)	1	0.98	9.8	7.7	16	1.9	0.86	0.62	3.6
Zinc (Zn+2)	0.007	0.0092	0.02	0.018	0.014	0.0069	0.0082	0.0093	0.022
Chloride (Cl-)	<10	< 10	10	<10	17	^<10	< 10	<10	< 10
Sulfate (SO4-2)	13	10	39	36	58	20	11	11	33
Fe+2 field spectroph.	0.03	0	0.00	0.00	0.00	N/C	NS	0.01	0.00
Fe+3 by difference	0.00	0.0091	0.00	0.02	0.00	0.00	0.02	0.02	0.00

Table 26. Water Quality Data Collected From the Mouth of Blair Creek at Sample Location Number 43 (SSPIIBLC01).

Date Sampled	05/08/96	06/12/96	07/16/96	08/21/96	09/23/96	10/16/96	11/18/96	02/18/97	3/20/97	04/16/97
pH - lab	5.81	4.74	3.11	3.13	3.00	3.04	4.74	4.84	5.48	4.13
pH - field	5.57	5	3.07	3.96	3.21	3.06	4.37	5.00	6.11	3.87
Acidity (mg/L CaCO3)	<10	< 10	150	120	150	170	10	< 10	<10	22
Temperature (deg C)	14.2	16.2	19.3	18.1	14.6	11.5	9.5	7.3	8.3	6.5
Conductivity (umhos/cm)	43	72	860	901	1160	1221	98	81	33	172
Dissolved Oxygen (mg/L)	10.3	13.8	9.2	10.0	9.0	9.0	11.7	11.2	11.1	11.4
Redox Potential (mVolts)	-39.3	20.6	199.6	280.6	286.6	203.6	80.6	514.4	407.4	1044.4
Alkalinity (mg/L CaCO3)	<20	20	-	-	-	^-	<20	< 20	<20	N/A
Measured TDS at 180 deg C	53	42	370	430	510	570	49	N/A	ND	N/A
Discharge Rate (cfs)	11.790	9.018	0.652	0.033	0.080	0.074	7.445	3.122	20.395	0.632
	(mg/L)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	0.047	0.36	5.4	5.7	8.1	8.2	0.26	0.12	< 0.024	0.74
Total Aluminum (Al+3)	0.4	0.59	4.8	5.7	7.9	8.4	0.63	0.38	0.8	0.83
Arsenic (As+3)	<0.0066	< 0.0066	< 0.0066	< 0.0066	^<0.0066	< 0.0066	< 0.0066	< 0.0066	< 0.0066	< 0.0066
Cadmium (Cd+2)	<0.001	< 0.001	< 0.0010	< 0.0010	^<0.0010	< 0.0010	<0.0010	<0.00085	<0.00085	< 0.00085
Calcium (Ca+2)	2.6	5.6	29	33	39	41	6.3	3.7	2.6	6.6
Chromium (Cr+3)	<0.001	< 0.001	< 0.0036 B	0.0027	^<0.0010	0.0029	< 0.0010	<0.0042	<0.0042	< 0.0042
Copper (Cu+2)	<0.0029	< 0.0029	0.025	< 0.0029	0.026	0.0046	<0.0025	0.012	<0.012	0.027
Iron (Fe)	0.32	0.74	12	11	15	19	1	1.4	0.21	4.1
Total Iron (Fe)	0.64	1.7	13	14	17	20	1.6	2	0.73	4.7
Lead (Pb+2)	<0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	<0.0011	<0.0011	<0.0011	< 0.0011
Magnesium (Mg+2)	1.1	2.1	12	12	16	16	2.1	1.7	1.2	2.8
Manganese (Mn+2)	0.033	0.41	2.3	2.8	3.3	3.6	0.21	0.18	0.098	0.41
Total Manganese (Mn+2)	0.037	0.17	2.4	2.8	3.2	3.5	0.18	0.18	0.089	0.42
Selenium (Se+4)	<0.0033	< 0.0033	< 0.0033	< 0.0033	^<0.0033	^< 0.0033	<0.0033	< 0.0066	<0.0066	< 0.0066
Sodium (Na+)	1.5	3.3	33	37	53	54	4.3	3.3	1.1	6.2
Zinc (Zn+2)	0.0037	0.02	0.11	0.11	0.11	0.11	0.011	0.038	0.014	0.022
Chloride (Cl-)	<10	< 10	19	19	24	29	<10	< 10	<10	< 10
Sulfate (SO4-2)	<10	24	260	270	360	400	32	21	<11	48
Fe+2 field spectroph.	0.35	0.03	2.74	0.28	1.58	2.7	0.97	0.95	0.19	2.15
Fe+3 by difference	0	0.71	9.26	10.72	13.42	16.3	0.03	0.45	0.02	1.95

Table 29. Water Quality Data Collected From the Mine #88 CMD Discharge at Sample Location Number 05 (SSPII8801).

Date Sampled	05/07/96	06/10/96	07/15/96	08/19/96	09/23/96	10/17/96	11/18/96	02/18/97	3/19/97	04/15/97
pH - lab	5.45	5.33	5.34	5.48	5.37	5.35	5.29	5.38	5.28	5.40
pH - field	5.33	5.46	5.00	* 5.8	* 6.1	5.19	5.30	5.30	5.31	5.15
Acidity (mg/L CaCO3)	340	520	300	510	520	500	500	430	400	470
Temperature (deg C)	14.1	14.7	15.0	15.1	14.9	14.9	13.7	14.4	14.1	14.3
Conductivity (umhos/cm)	2890	2630	3520	3535	3570	3770	3820	3060	2850	3280
Dissolved Oxygen (mg/L)	2.7	N/A	4.0	3.0	1.2	1.4	1.6	5.6	3.3	1.7
Redox Potential (mVolts)	-87.5	N/A	-112.4	-181.4	-173.4	-166.4	-156.4	382.4	442.4	904.4
Alkalinity (mg/L CaCO3)	<20	20	20	24	44	54	48	20	60	30
Measured TDS at 180 deg C	2500	3200	3300	3500	3600	3400	3700	2900	2600	2900
Discharge Rate (cfs)	0.200	0.130	0.184	0.180	0.080	0.248	0.100	0.100	0.063	0.036
	(mg/L)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	0.54	0.61	0.39	0.51	0.53	0.5	0.72	0.54	0.41	0.39
Total Aluminum (Al+3)	0.6	0.66	0.41	0.52	0.54	0.49	0.56	0.61	0.51	0.4
Arsenic (As+3)	<0.0066	< 0.0066	< 0.013	0.014	0.015	0.013	< 0.0066	< 0.0066	<0.0066	< 0.0066
Cadmium (Cd+2)	<0.001	< 0.001	< 0.010	< 0.020	0.015	<0.0010	0.011	<0.00085	<0.00085	< 0.00085
Calcium (Ca+2)	140	160	180	190	190	180	240	170	140	150
Chromium (Cr+3)	<0.001	< 0.001	< 0.0036 B	< 0.0010	^<0.0010	< 0.0010	<0.0010	<0.0042	<0.0042	< 0.0042
Copper (Cu+2)	<0.0029	< 0.0043	< 0.0029	< 0.0029	0.01	< 0.0029	< 0.0025	0.012	<0.012	< 0.0025
Iron (Fe)	220	270	310	370	390	330	310	240	210	260
Total Iron (Fe)	210	260	350	330	350	400	320	240	200	260
Lead (Pb+2)	<0.0011	< 0.0022	< 0.0022	< 0.0011	^<0.0011	< 0.0011	<0.0011	< 0.0011	< 0.0011	< 0.0011
Magnesium (Mg+2)	61	69	76	76	80	76	81	64	61	70
Manganese (Mn+2)	8.7	9.8	11	11	11	12	12	8.9	8.6	9.8
Total Manganese (Mn+2)	9.2	10	11	12	11	11	13	9.9	8.4	10
Selenium (Se+4)	<0.0033	< 0.0066	< 0.0066	< 0.0066	^<0.0066	^<0.0033	<0.0066	< 0.0066	< 0.0066	< 0.0066
Sodium (Na+)	390	420	420	500	500	570	500	400	350	610
Zinc (Zn+2)	0.075	0.094	0.12	0.16	< 0.028	0.09	0.12	0.11	0.094	0.092
Chloride (Cl-)	41	50	44	57	60	48	50	54	50	50
Sulfate (SO4-2)	1700	2100	2200	2000	2100	2200	2400	1100	650	1900
Fe+2 field spectroph.	180	133	150	82	82	140	255	NS	147	265*
Fe+3 by difference	40	137	160	288	308	190	55	240	63	0

Table 31. Water Quality Data For the Discharge Emanating From the Laurel Branch Spoil at Sample Location Number 39 (SSPIILBC01).

Date Sampled	05/07/96	06/11/96	07/16/96	08/20/96	09/18/96	10/16/96	11/19/96	02/18/97	3/20/97	04/16/97
pH - lab	2.58	2.69	2.73	2.70	2.72	2.79	2.52	2.72	2.97	2.86
pH - field	2.60	N/D	3.06	* 2.5	2.81	2.62	2.54	2.50	3.35	2.71
Acidity (mg/L CaCO3)	750	510	500	510	570	610	1300	600	300	500
Temperature (deg C)	12.2	15.2	25.3	30.4	22.5	19.2	12.9	14.1	10.1	14.5
Conductivity (umhos/cm)	1736	1285	1395	1730	1751	1395	2780	NS	1003	1443
Dissolved Oxygen (mg/L)	0.8	10.2	1.0	3.2	4.5	2.9	1.5	0.6	7.6	5.3
Redox Potential (mVolts)	-24.0	224.6	173.6	213.6	226.6	207.6	206.6	691.4	754.4	712.4
Alkalinity (mg/L CaCO3)	N/A	-	-	-	-	^-	N/A	N/A	ND	N/A
Measured TDS at 180 deg C	960	770	700	1000	980	930	1700	920	260	580
Discharge Rate (cfs)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	(mg/L)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	39	25	20	25	30	30	89	33	11	18
Total Aluminum (Al+3)	40	32	49	36	40	39	110	35	10	20
Arsenic (As+3)	<0.0066	< 0.0066	< 0.0066	< 0.0066	^<0.0066	^<0.0066	< 0.0066	<0.0066	<0.0066	< 0.0066
Cadmium (Cd+2)	<0.001	< 0.001	< 0.0010	< 0.0010	0.0073	< 0.0010	0.01	<0.00085	<0.00085	< 0.00085
Calcium (Ca+2)	15	13	13	16	18	19	31	16	8.3	11
Chromium (Cr+3)	0.044	0.026	0.02	0.03	0.003	0.028	0.084	0.031	0.0076	0.017
Copper (Cu+2)	0.16	0.071	0.03	0.074	0.036	0.032	0.16	0.062	0.027	0.028
Iron (Fe)	120	96	87	110	120	110	250	130	11	75
Total Iron (Fe)	130	110	230	150	170	130	360	130	11	84
Lead (Pb+2)	<0.0011	< 0.0011	0.0024	0.0025	^<0.0011	^<0.0011	^<0.0011	<0.0011	<0.0011	< 0.0011
Magnesium (Mg+2)	9.1	8.6	8.7	11	13	13	20	9.3	4	8.1
Manganese (Mn+2)	2.1	1.8	2.1	3	3.2	3.1	4.9	2.3	0.59	1.6
Total Manganese (Mn+2)	1.8	1.9	2.2	3	3	3.3	4.6	2.3	0.62	1.5
Selenium (Se+4)	<0.0033	< 0.0033	< 0.0033	<0.0066	^<0.0033	^<0.0033	^<0.0066	<0.0066	< 0.0066	< 0.0066
Sodium (Na+)	1.6	1.9	2.9	3.7	4.4	4.4	4.1	2.3	1.8	2
Zinc (Zn+2)	0.15	0.12	0.11	0.15	0.14	0.14	0.27	0.14	0.061	0.11
Chloride (Cl-)	11	< 10	< 10	<100	^<10	14	^<200	< 50	<10	< 50
Sulfate (SO4-2)	920	67	620	670	690	730	1600	420	210	460
Fe+2 field spectroph.	24.6	19.9	26.1	40	63.6	38	126	71	0.18	27.2
Fe+3 by difference	95.4	76.1	60.9	70	56.4	72	124	59	10.82	47.8

Table 32. Water Quality Data Collected From the Mouth of Nancy Graves Creek at Sample Location Number 15 (SSPIINGC01).

Date Sampled	05/09/96	06/13/96	10/17/96	11/19/96	02/18/97	3/21/97	04/17/97
pH - lab	4.10	3.58	2.85	3.23	3.76	4.11	3.53
pH - field	3.78	4.05	2.76	3.41	3.50	3.70	3.26
Acidity (mg/L CaCO3)	40	90	270	88	32	18	80
Temperature (deg C)	15.2	17.8	14.5	10.6	9.4	11.0	11.2
Conductivity (umhos/cm)	157	410	1591	555	316	127	585
Dissolved Oxygen (mg/L)	9.2	14	8.6	N/C	10.2	10.2	10.1
Redox Potential (mVolts)	117.0	268.6	310.6	276.6	748.4	641.4	658.4
Alkalinity (mg/L CaCO3)	N/A	NA	^-	N/A	N/A	ND	N/A
Measured TDS at 180 deg C	74	180	1200	310	160	67	270
Discharge Rate (cfs)	0.530	0.572	0.005	0.157	0.470	1.133	0.078
	(mg/L)	**(mg/l)**	**(mg/l)**	**(mg/l)**	**(mg/l)**	**(mg/l)**	**(mg/l)**
Aluminum (Al+3)	1.3	2.8	17	4.1	1.7	0.91	3.1
Total Aluminum (Al+3)	1.5	3.1	17	4.3	1.9	1.9	3.2
Arsenic (As+3)	<0.0066	< 0.0066	^<0.0066	^<0.0066	< 0.0066	< 0.0066	< 0.0066
Cadmium (Cd+2)	<0.001	< 0.001	^<0.0010	^<0.0010	<0.00085	<0.00085	< 0.00085
Calcium (Ca+2)	7.4	17	110	19	12	5.9	27
Chromium (Cr+3)	<0.001	< 0.001	0.0064	^<0.0010	<0.0042	<0.0042	< 0.0042
Copper (Cu+2)	0.0046	0.01	0.015	^<0.0025	0.012	<0.012	< 0.0025
Iron (Fe)	0.86	2.1	21	4	1.5	0.54	2
Total Iron (Fe)	1.2	2.6	23	4.7	1.6	1.1	2.3
Lead (Pb+2)	<0.0011	< 0.0011	< 0.0011	^<0.0011	<0.0011	0.0091	< 0.0011
Magnesium (Mg+2)	4.3	8.5	51	9	6.4	3.2	14
Manganese (Mn+2)	1.1	2.8	18	3.1	1.9	0.85	4.1
Total Manganese (Mn+2)	1.1	2.7	18	3.2	1.8	0.83	4.4
Selenium (Se+4)	<0.0033	< 0.0033	^<0.0033	^<0.0033	<0.0066	<0.0066	< 0.0066
Sodium (Na+)	3.1	7.4	65	8.7	5.5	2	14
Zinc (Zn+2)	0.023	0.054	0.21	0.046	0.032	0.019	0.062
Chloride (Cl-)	<10	< 10	^<10	^<10	<10	<10	10
Sulfate (SO4-2)	64	100	980	170	53	44	210
Fe+2 field spectroph.	0.29	0.38	0.73	0.61	NS	0.11	0.52
Fe+3 by difference	0.57	1.72	20.27	3.39	1.50	0.43	1.48

Table 34. Water Quality Data Collected From the Worley Mine #86 CMD Discharge at Sample Location Number 04 (SSPII8601).

Date Sampled	05/07/96	06/10/96	07/15/96	08/19/96	09/18/96	10/17/96	11/18/96	02/18/97	3/19/97	04/15/97
pH - lab	5.65	5.39	5.40	5.56	5.62	5.62	6.14	5.69	5.75	5.56
pH - field	5.46	5.41	5.50	7.38	* 7.0	5.14	5.82	5.50	6.12	5.65
Acidity (mg/L CaCO3)	330	420	340	240	120	110	N/A	< 10	<10	210
Temperature (deg C)	13.8	14.5	13.8	15.2	14.5	14.4	12.2	11.6	10.5	14.3
Conductivity (umhos/cm)	2040	1945	2750	2550	2910	1824	1200	150	160	2720
Dissolved Oxygen (mg/L)	3.1	N/A	3.0	1.2	0.6	2.1	1.0	7.8	9.0	0.6
Redox Potential (mVolts)	-75.0	N/A	-122.4	-216.4	-197.4	-164.4	-205.4	516.4	725.4	814.4
Alkalinity (mg/L CaCO3)	<20	< 20	< 20	42	44	66	30	20	22	70
Measured TDS at 180 deg C	1500	2300	2400	2200	1500	1300	140	100	160	1800
Discharge Rate (cfs)	3.024	0.407	0.178	0.053	0.030	0.023	0.063	0.005	0.150	0.108
	(mg/L)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	0.085	0.16	< 0.026	0.12	< 0.026	< 0.026	< 0.024	<0.024	< 0.024	0.06
Total Aluminum (Al+3)	0.16	0.16	< 0.026	0.1	0.17	< 0.026	0.24	0.68	1.8	0.068
Arsenic (As+3)	<0.0066	< 0.0066	< 0.0066	< 0.0066	< 0.0066	^<0.0066	<0.0066	< 0.0066	< 0.0066	< 0.0066
Cadmium (Cd+2)	<0.001	< 0.001	< 0.010	< 0.0010	0.0056	^<0.0010	<0.0010	<0.00085	<0.00085	< 0.00085
Calcium (Ca+2)	74	140	170	140	100	91	19	8.3	12	100
Chromium (Cr+3)	<0.001	< 0.001	< 0.0036 B	< 0.0010	< 0.0010	^<0.0010	<0.0010	<0.0042	<0.0042	< 0.0042
Copper (Cu+2)	<0.0029	< 0.0043	< 0.0029	0.0033	0.0086	^<0.0029	< 0.0025	<0.0025	<0.012	< 0.0025
Iron (Fe)	110	210	190	170	110	77	5.1	0.022	0.48	110
Total Iron (Fe)	110	200	220	150	140	95	9	0.96	2.3	100
Lead (Pb+2)	<0.0011	< 0.0022	< 0.0011	< 0.0011	< 0.0011	^<0.0011	<0.0011	< 0.0011	< 0.0011	< 0.0011
Magnesium (Mg+2)	38	59	61	56	45	31	5.8	3.2	4.5	44
Manganese (Mn+2)	6.6	9.2	11	9.6	8.6	7.2	0.71	0.25	0.41	7.7
Total Manganese (Mn+2)	7	9.3	9.9	9.7	8.6	8.1	0.63	0.27	0.45	8
Selenium (Se+4)	<0.0033	< 0.0033	< 0.0033	< 0.0033	^<0.0033	^<0.0033	<0.0033	< 0.0066	< 0.0066	< 0.0066
Sodium (Na+)	220	340	300	330	260	220	21	12	11	330
Zinc (Zn+2)	0.068	0.088	0.12	0.083	0.056	0.033	0.0064	0.0082	0.015	0.07
Chloride (Cl-)	24	32	32	<50	^<10	20	12	< 10	<10	< 50
Sulfate (SO4-2)	1000	1700	1700	1200	900	850	95	48	60	1300
Fe+2 field spectroph.	2.51	63	85	121	103	69	N/C	0	0.41	157*
Fe+3 by difference	107.49	147	105	49	7	8	5.1	0.022	0.07	0

Table 36. Water Quality Data Collected From Slavey Hollow at Sample Location Number 07 (SSPIISH02 and SSPIISH04).

Date Sampled	05/10/96	06/13/96	07/17/96	08/21/96	09/23/96	10/17/96	11/21/96	02/18/97	3/21/97	04/17/97
pH - lab	7.22	6.92	7.04	7.02	7.01	7.04	6.86	6.22	5.95	6.16
pH - field	6.88	7.08	7.34	7.88	7.56	6.75	7.63	6.10	5.70	6.10
Acidity (mg/L CaCO3)	<10	< 10	<10	-	-	^-	N/A	N/A	ND	N/A
Temperature (deg C)	15.1	15.2	16.3	16.5	15.2	14.9	12.0	12.9	13.0	13.5
Conductivity (umhos/cm)	595	892	1255	1192	1148	1181	642	752	750	1019
Dissolved Oxygen (mg/L)	10.0	12.6	10.4	9.2	9.6	9.1	7.2	4.6	4.9	2.5
Redox Potential (mVolts)	-124.0	-263.4	-225.4	-296.4	-319.4	-296.4	-103.4	348.4	263.4	114.4
Alkalinity (mg/L CaCO3)	51	72	180	100	98	110	68	120	62	120
Measured TDS at 180 deg C	370	570	840	840	780	760	450	540	460	650
Discharge Rate (cfs)	0.710	4.125	1.264	0.586	0.325	0.412	0.815	0.645	0.264	0.330
	(mg/L)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Aluminum (Al+3)	0.062	0.046	< 0.026	0.063	< 0.026	< 0.026	^<0.024	0.12	0.26	< 0.024
Total Aluminum (Al+3)	1.2	1.8	1.8	1.8	2.1	1.8	1.2	0.12	0.82	0.21
Arsenic (As+3)	<0.0066	< 0.0066	< 0.0066	<0.0066	^<0.0066	^<0.0066	^<0.0066	<0.0066	<0.0066	< 0.0066
Cadmium (Cd+2)	<0.001	< 0.001	< 0.0010	< 0.0010	^<0.0010	^< 0.0010	^<0.0010	<0.00085	<0.00085	< 0.00085
Calcium (Ca+2)	25	39	55	61	48	50	28	32	29	42
Chromium (Cr+3)	<0.001	< 0.001	< 0.0036 B	<0.0010	^<0.0010	^< 0.0010	^<0.0010	<0.0042	<0.0042	< 0.0042
Copper (Cu+2)	0.14	< 0.0029	< 0.0029	<0.0029	< 0.0029	^< 0.0029	^<0.0025	0.012	<0.012	< 0.0025
Iron (Fe)	3.3	6.3	8.4	7.1	6.4	6.1	4	6.8	5.7	10
Total Iron (Fe)	5.3	12	16	14	13	15	12	8	6.5	12
Lead (Pb+2)	<0.0011	< 0.0011	< 0.0011	<0.0011	^<0.0011	^<0.0011	^<0.0011	<0.0011	<0.0011	< 0.0011
Magnesium (Mg+2)	11	17	22	21	20	18	12	12	11	17
Manganese (Mn+2)	1.3	2.3	3.5	3.2	2.9	2.9	1.6	1.9	1.8	2.6
Total Manganese (Mn+2)	1.3	2.3	3.1	3.1	2.8	2.8	1.6	1.9	1.6	2.6
Selenium (Se+4)	<0.0033	< 0.0033	< 0.0033	< 0.0033	^<0.0033	^<0.0033	^<0.0033	< 0.0066	<0.0066	< 0.0066
Sodium (Na+)	74	110	200	170	200	160	94	110	96	210
Zinc (Zn+2)	0.024	0.028	0.023	0.037	0.021	0.019	0.055	0.019	0.038	0.02
Chloride (Cl-)	<10	< 10	< 10	10	12	18	^<10	10	12	50
Sulfate (SO4-2)	260	310	520	490	480	480	270	290	290	400
Fe+2 field spectroph.	1.55	2.41	3.52	0.54	3.16	3.72	1.60	NS	4.60	9.70
Fe+3 by difference	1.75	3.89	4.88	6.56	3.24	2.38	2.40	6.80	1.10	0.30

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APPENDIX E
Wildlife Species Known to Occur in McCreary County, Kentucky

Source: Kentucky Fish and Wildlife Information Systems (KFWIS)
Web site: **http://www.kfwis.state.ky.us/KFWIS/SpeciesInfo/selectCountyQuad/FrameMain.htm**.

MAMMALS

beaver (*Castor canadensis*)	common gray fox (*Urocyon cinereoargenteus*)
common raccoon (*Procyon lotor*)	eastern chipmunk (*Tamias striatus*)
eastern gray squirrel (*Sciurus carolinensis*)	evening bat (*Nycticeius humeralis*)
Indiana myotis (*Myotis sodalis*)	Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)
striped skunk (*Mephitis mephitis*)	Virginia opossum (*Didelphis virginiana*)
white-tailed deer (*Odocoileus virginianus*)	

BIRDS

hairy woodpecker (*Picoides villosus*)	acadian flycatcher (*Empidonax virescens*)
American crow (*Corvus brachyrhynchos*)	American goldfinch (*Carduelis tristis*)
American kestrel (*Falco sparverius*)	American redstart (*Setophaga ruticilla*)
American robin (*Turdus migratorius*)	American woodcock (*Scolopax minor*)
barn swallow (*Hirundo rustica*)	barred owl (*Strix varia*)
belted kingfisher (*Ceryle alcyon*)	black-and-white warbler (*Mniotilta varia*)
blackpoll warbler (*Dendroica striata*)	black-throated green warbler (*Dendroica virens*)
blue grosbeak (*Guiraca caerulea*)	blue jay (*Cyanocitta cristata*)
blue-gray gnatcatcher (*Polioptila caerulea*)	blue-winged warbler (*Vermivora pinus*)
bobolink (*Dolichonyx oryzivorus*)	broad-winged hawk (*Buteo platypterus*)
brown thrasher (*Toxostoma rufum*)	brown-headed cowbird (*Molothrus ater*)
Canada goose (*Branta canadensis*)	Carolina chickadee (*Parus carolinensis*)
Carolina wren (*Thryothorus ludovicianus*)	cedar waxwing (*Bombycilla cedrorum*)
Cerulean warbler (*Dendroica cerulea*)	chimney swift (*Chaetura pelagica*)
chipping sparrow (*Spizella passerina*)	common grackle (*Quiscalus quiscula*)
common yellowthroat (*Geothlypis trichas*)	dark-eyed junco (*Junco hyemalis*)
downy woodpecker (*Picoides pubescens*)	eastern bluebird (*Sialia sialis*)
eastern kingbird (*Tyrannus tyrannus*)	eastern meadowlark (*Sturnella magna*)
eastern Phoebe (*Sayornis phoebe*)	eastern wood-pewee (*Contopus virens*)
European starling (*Sturnus vulgaris*)	field sparrow (*Spizella pusilla*)
grasshopper sparrow (*Ammodramus savannarum*)	gray catbird (*Dumetella carolinensis*)
great crested flycatcher (*Myiarchus crinitus*)	green heron (*Butorides virescens*)
hooded warbler (*Wilsonia citrina*)	horned lark (*Eremophila alpestris*)
house finch (Carpodacus mexicanus)	house sparrow (*Passer domesticus*)
house wren (*Troglodytes aedon*)	indigo bunting (*Passerina cyanea*)
Kentucky warbler (*Oporornis formosus*)	killdeer (*Charadrius vociferus*)
Lousiana waterthrush (*Seiurus motacilla*)	migrant loggerhead shrike (*Lanius ludovicianus*)
mourning dove (*Zenaida macroura*)	northern bobwhite (*Colinus virginianus*)
northern cardinal (*Cardinalis cardinalis*)	northern flicker (*Colaptes auratus*)
northern mockingbird (*Mimus polyglottos*)	northern parula (*Parula americana*)
northern rough-winged swallow (*Stelgidopteryx serripennis*)	orchard oriole (*Icterus spurius*)

ovenbird (*Seiurus aurocapillus*)	pileated woodpecker (*Dryocopus pileatus*)
pine siskin (*Carduelis pinus*)	pine warbler (*Dendroica pinus*)
prairie warbler (*Dendroica discolor*)	prothonotary warbler (*Protonotaria citrea*)
purple martin (*Progne subis*)	red-bellied woodpecker (*Melanerpes carolinus*)
red-eyed vireo (*Vireo olivaceus*)	red-headed woodpecker (*Melanerpes erythrocephalus*)
red-shouldered hawk (*Buteo lineatus*)	red-tailed hawk (*Buteo jamaicensis*)
red-winged blackbird (*Agelaius phoeniceus*)	ruby-throated hummingbird (*Archilochus colubris*)
ruffed grouse (*Bonasa umbellus*)	rufous-sided towhee (*Pipilo erythrophthalmus*)
scarlet tanager (*Piranga olivacea*)	sharp-shinned hawk (*Accipiter striatus*)
solitary vireo (*Vireo solitarius*)	song sparrow (*Melospiza melodia*)
summer tanager (*Piranga rubra*)	tree swallow (*Tachycineta bicolor*)
tufted titmouse (*Parus bicolor*)	turkey vulture (*Cathartes aura*)
Whip-poor-will (*Caprimulgus vociferus*)	white-breasted nuthatch (*Sitta carolinensis*)
white-eyed vireo (*Vireo griseus*)	wild turkey (*Meleagris gallopavo*)
willow flycatcher (*Empidonax traillii*)	wood duck (*Aix sponsa*)
wood thrush (*Hylocichla mustelina*)	worm-eating warbler (*Helmitheros vermivorus*)
yellow warbler (*Dendroica petechia*)	yellow-billed cuckoo (*Coccyzus americanus*)
yellow-breasted chat (*Icteria virens*)	yellow-throated vireo (*Vireo flavifrons*)
yellow-throated warbler (*Dendroica dominica*)	

REPTILES

black rat snake (*Elaphe obsoleta*)	coal skink (*Eumeces anthracinus*)
common garter snake (*Thamnophis sirtalis*)	DeKay's brown snake (*Storeria dekayi*)
eastern box turtle (*Terrapene carolina*)	eastern fence lizard (*Sceloporus undulatus*)
eastern spiny softshell turtle (*Apalone spinifera*)	eastern worm snake (*Carphophis amoenus*)
five-lined skink (*Eumeces fasciatus*)	ground skink (*Scincella lateralis*)
northern black racer (*Coluber constrictor*)	northern fence lizard (*Sceloporus undulatus*)
northern redbelly snake (*Storeria occipitomaculata*)	northern ringneck snake (*Diadophis punctatus*)
red-bellied snake (*Storeria occipitomaculata*)	slender glass lizard (*Ophisaurus attenuatus*)
snapping turtle (*Chelydra serpentina*)	stinkpot (*Sternotherus odoratus*)
timber rattlesnake (*Crotalus horridus*)	western smooth earth snake (*Virginia valeriae*)
worm snake (Carphophis amoenus)	

AMPHIBIANS

American toad (*Bufo americanus*)	black mountain salamander (*Desmognathus welteri*)
bullfrog (*Rana catesbeiana*)	cave salamander (*Eurycea lucifuga*)
Cope's gray treefrog (*Hyla chrysoscelis*)	eastern narrowmouth toad (*Gastrophryne carolinensis*)
eastern spadefoot (*Scaphiopus holbrookii*)	four-toed salamander (*Hemidactylium scutatum*)
Fowler's toad (*Bufo woodhousei*)	green frog (*Rana clamitans*)
green salamander (*Aneides aeneus*)	Kentucky spring salamander (*Gyrinophilus porphyriticus*)
marbled salamander (*Ambystoma opacum*)	northern dusky salamander (*Desmognathus fuscus*)

northern red salamander (*Pseudotriton ruber*)	northern slimy salamander (*Plethodon glutinosus*)
northern spring (subsp: crucifer) peeper (*Hyla crucifer*)	pickerel frog (*Rana palustris*)
red-spotted newt (*Notophthalmus viridescens*)	seal salamander (*Desmognathus monticola*)
southern two-lined salamander (*Eurycea cirrigera*)	spring peeper (*Hyla crucifer*)
two-lined salamander (*Eurycea bislineata*)	wood frog (*Rana sylvatica*)
zigzag salamander (*Plethodon dorsalis*)	

FISH

arrow (subsp: spilotum) darter (*Etheostoma sagitta*)	ashy darter (*Etheostoma cinereum*)
banded darter (*Etheostoma zonale*)	banded sculpin (*Cottus carolinae*)
barcheek darter (*Etheostoma obeyense*)	bigeye chub (*Notropis amplops*)
black bullhead (*Ameiurus melas*)	black redhorse (*Moxostoma duquesnei*)
blacknose dace (*Rhinichthys atratulus*)	blackside dace (*Phoxinus cumberlandensis*)
blackside darter (*Percina maculata*)	bloodfin darter (*Etheostoma sanguifluum*)
bluegill (*Lepomis macrochirus*)	bluntnose minnow (*Pimephales notatus*)
brook silverside (*Labidesthes sicculus*)	central stoneroller (*Campostoma anomalum*)
channel catfish (*Ictalurus punctatus*)	channel darter (*Percina copelandi*)
common carp (*Cyprinus carpio*)	creek chub (*Semotilus atromaculatus*)
dusky darter (*Percina sciera*)	emerald darter (*Etheostoma baileyi*)
emerald shiner (*Notropis atherinoides*)	fantail darter (*Etheostoma flabellare*)
freshwater drum (*Aplodinotus grunniens*)	giant floater (*Anodonta grandis*)
gizzard shad (*Dorosoma cepedianum*)	golden redhorse (*Moxostoma erythrurum*)
green sunfish (*Lepomis cyanellus*)	greenside darter (*Etheostoma blennioides*)
Johnny darter (*Etheostoma nigrum*)	lake sturgeon (*Acipenser fulvescens*)
largemouth bass (*Micropterus salmoides*)	largescale stoneroller (*Campostoma oligolepis*)
flathead catfish (*Pylodictis olivaris*)	least brook lamprey (*Lampetra aepyptera*)
longear sunfish (*Lepomis megalotis*)	mimic shiner (*Notropis volucellus*)
northern hogsucker (*Hypentelium nigricans*)	northern studfish (*Fundulus catenatus*)
Ohio lamprey (*Ichthyomyzon bdellium*)	olive darter (*Percina squamata*)
Palezone shiner (*Notropis albizonatus*)	Popeye shiner (*Notropis ariommus*)
rainbow darter (*Etheostoma caeruleum*)	rainbow trout (*Oncorhynchus mykiss*)
redbreast sunfish (*Lepomis auritus*)	river redhorse (*Moxostoma carinatum*)
rock bass (*Ambloplites rupestris*)	rosefin shiner (*Notropis ardens*)
rosyface shiner (*Notropis rubellus*)	sand shiner (*Notropis stramineus*)
sauger (*Stizostedion canadense*)	sawfin shiner (*Notropis* sp., undescribed)
shorthead redhorse (*Moxostoma macrolepidotum*)	silver redhorse (*Moxostoma anisurum*)
silver shiner (*Notropis photogenis*)	silverjaw minnow (*Ericymba buccata*)
smallmouth bass (*Micropterus dolomieui*)	smallscale darter (*Etheostoma microlepidum*)
southern redbelly dace (*Phoxinus erythrogaster*)	speckled darter (*Etheostoma stigmaeum*)
spotfin shiner (*Cyprinella spiloptera*)	spotted bass (*Micropterus punctulatus*)
spotted salamander (*Ambystoma maculatum*)	steelcolor shiner (*Cyprinella whipplei*)
stonecat (*Noturus flavus*)	striped bass (*Morone saxatilis*)
striped darter (*Etheostoma virgatum*)	striped shiner (*Luxilus chrysocephalus*)
stripetail darter (*Etheostoma kennicotti*)	telescope shiner (*Notropis telescopus*)
Tippecanoe darter (*Etheostoma tippecanoe*)	walleye (*Stizostedion vitreum*)
western sand darter (*Ammocrypta clara*)	white bass (*Morone chrysops*)

white sucker (*Catostomus commersoni*)	whitetail shiner (*Cyprinella galactura*)

MOLLUSKS

armored rocksnail (*Lithasia armigera*)	black sandshell (*Ligumia recta*)
butterfly (*Ellipsaria lineolata*)	Cumberland bean (*Villosa trabalis*)
Cumberland elktoe (*Alasmidonta atropurpurea*)	Cumberland moccasinshell (*Medionidus conradicus*)
Cumberlandian combshell (*Epioblasma brevidens*)	elephant-ear (*Elliptio crassidens*)
elktoe (*Alasmidonta marginata*)	fluted kindeyshell (*Ptychobranchus subtentum*)
fluted-shell (*Lasmigona costata*)	fragile papershell (*Leptodea fragilis*)
kidneyshell (*Ptychobranchus fasciolaris*)	lilliput (*Toxolasma parvus*)
little spectaclecase (*Villosa lienosa*)	little-wing pearlymussel (*Pegias fabula*)
logperch (*Percina caprodes*)	oyster mussel (*Epioblasma capsaeformis*)
painted creekshell (*Villosa taeniata*)	pheasantshell (*Actinonaias pectorosa*)
pimpleback (*Quadrula pustulosa*)	pink heelsplitter (*Potamilus alatus*)
pistolgrip (*Tritogonia verrucosa*)	plain pocketbook (*Lampsilis cardium*)
pocketbook (*Lampsilis ovata*)	purple lilliput (*Toxolasma lividus*)
purple wartyback (*Cyclonaias tuberculata*)	rainbow (*Villosa iris*)
round hickorynut (*Obovaria subrotunda*)	round pigtoe (*Pleurobema coccineum*)
slipper shell (*Alasmidonta calceolus*)	spike (*Elliptio dilatata*)
squawfoot (*Strophitus undulatus*)	Tennessee clubshell (*Pleurobema oviforme*)
wavy-rayed lampmussel (*Lampsilis fasciola*)	